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INSTITUTE OF GAS TECHNOLOGY

THE GAS INDUSTRY'S OWN EDUCATIONAL AND RESEARCH FACILITY

CHICAGO 16, ILLINOIS

GAS ABSTRACTS

FEBRUARY, 1960

VOLUME 16 NUMBER 2

AFFILIATED WITH

ILLINOIS INSTITUTE OF TECHNOLOGY

CONTENTS

1. **Management**—Gas industry progress, business problems, statistics, government regulation, safety, personnel, education..... 25

2. **Energy Supply and Economics**—Resources, reserves, and competitive applications of the fossil fuels and other sources of energy, including nuclear and solar energy..... 27

3. **Natural Gas and Petroleum Production**—Geology, exploration, drilling, well management, reservoir engineering..... 28

4. **Gas Conditioning and LPG Recovery**—Condensate, dust, CO_2 and sulfur removal, dehydration, odorization, oil fogging, humidification; LPG recovery and refining..... 30

5. **Natural Gas Transmission**—Pipelines, compressors, dispatching, flow regulation, communications, maintenance..... 32

6. **Gas and LPG Storage**—Holders, pressure tanks, underground storage; liquefaction, refrigerated storage..... 34

7. **Manufactured Gas and Chemical Processing**—Gasification of coal, oil; reformed gas; chemical treatment; byproducts; synthesis gas production and conversion; petrochemicals; catalysts, catalyst development..... 35

8. **Gas Distribution**—City utility systems: design, operation, maintenance; weather influence on peak loads and supply; LPG-air mixtures..... 37

9. **Gas Fuel Utilization and Appliances**—Domestic, commercial, industrial; burners; combustion research; air pollution..... 38

10. **Equipment and Instrumentation**—Production and handling equipment, and maintenance; computers; controls; measurement..... 40

11. **Materials of Construction, and Corrosion**—Metals, refractories, plastics; corrosion measurement, prevention..... 42

12. **Analytical Methods and Tests**—Standard and research techniques for gas-making materials, products, processes; instrumental analysis..... 43

13. **Basic Science**—Chemistry, physics and basic engineering related to gas technology; physical properties of gases: phase equilibria, thermodynamics, reaction kinetics, heat and mass transfer, fluid flow..... 44

Services Available to Readers—Photocopies, microfilm, Russian translations, bibliographies and literature searches, *Gas Abstracts on Cards*, back numbers of *Gas Abstracts*.....**Inside Back Cover**

Publications Abstracted for Gas Abstracts.....**Back Cover**

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GAS ABSTRACTS is published and distributed monthly by the Institute of Gas Technology, Chicago 16, Illinois. The contents of selected papers and patents are reviewed impartially by the editorial staff and material of potential interest to the Gas Industry is presented.

Subscription rates to nonmembers of the Institute: $18.00 per year to U. S. addresses; $22.00 foreign. Regardless of the month in which it is entered, each subscription starts with the January issue. A gold-stamped fabrikoid binder for the year, and title- and end-pages for that volume, are sent with the January issue. A complete index to the year's issues is mailed as soon after the year's end as it can be prepared, edited and printed.

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A microfilm edition of Gas Abstracts can be supplied by University Microfilms, 313 N. First St., Ann Arbor, Michigan.

1. MANAGEMENT

Gas Industry Management

Current Factors in Gas Producer Rate Cases. F. Stueck. *Public Util. 65,* 145 (1960) Feb. 4 (9 pp.)

Author suggests than an expanded conference consisting of the Natural Gas Industry Conference, augmented by representatives of the National Assoc. of Railroad and Utilities Commissioners work in close liaison with the FPC to work out standard forms of contracts, level the peaks and fill the valleys of annual consumption, and take real steps in the development of exploration, production, transportation, distribution and uses of natural gas. It is suggested that the FPC reach tentative conclusions as to current and going prices in each known producing area and to arrive at ceiling prices for old gas, and ceiling initial prices for new gas. With the approval of all segments of the industry, action for the future could then be taken.

Intrastate Gas Sales Are Booming. *Petrol. Week 10,* 15 (1960) Jan. 22 (3 pp.)

Substantial quantities of gas that normally would be dedicated to interstate markets are now being committed to intrastate sales. Producers feel that intrastate agreements are firm, and much less difficult to negotiate than federally controlled interstate contracts. Wellhead prices and profits are basically as good. Possible disadvantage to producers: the thrust for intrastate markets might cause a sag in gas prices.

Pipeline Purchases from Producers—1958. *Gas Age 125,* 21 (1960) Jan. 21 (11 pp.)

Special analysis of pipeline purchases, covering 91% of direct sales by producers, shows an average price paid per MCF of 13.0 cents by pipelines for their gas needs in 1958. Average in 1957 was 11.9 cents and in 1956, 11.2 cents. Sales and average prices are listed for producers whose sales were two million MCF or more. Six purchasers bought more than 250 billion CF, with United Gas Pipe Line the largest—more than one trillion CF annually.

Price of Gulf Coast Gas Hits New High. *Oil Gas J. 58,* 61 (1960) Feb. 1.

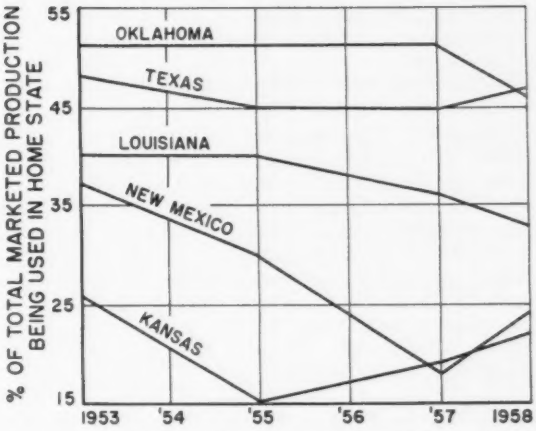
Gulf Oil Corp. and Tidewater Oil Co. have sold one trillion CF of gas in the most widely sought reserve (Bastian Bay) on the Gulf Coast for record price (22.5 cents/MCF) plus full tax reimbursement to United Gas Pipe Line Co. Price escalates to 25 cents on July 1, 1962, and is subject to redetermination each five years thereafter. Level is to be geared to an average of the two top prices paid for South Louisiana gas in the intervening period. Only hitch: FPC must approve the sale.

Gas Industry Expansion

(LPG) Yearly Sales Could Reach 26 Billion Gallons by 1970. J. J. Pareti. *LP-Gas 20,* 27 (1960) Feb. (3 pp.)

Despite recessions and economic problems in some sections of the country, LPG industry during the past 15 years has set impressive growth records. By 1970, the industry may be selling 16 billion gallons of LPG for domestic and allied usage and 10.5 billion gallons for chemical and other uses. Backing up this possible gain are anticipated increases in population, income, and new construction.

Intrastate Trend Is Showing in Three out of Five Gas States



(Adapted from *Intrastate Gas Sales . . .* left)

Natural Gas in 1960. R. L. Conkling. *World Oil 150,* 78 (1960) Feb. 1. (4 pp.).

Author discusses issues which will determine progress of gas industry in 1960. Among the more important ones: coal stimulated movement toward a national fuels policy; conservation, inferior vs superior uses; nonjurisdictional intrastate markets; new gas bill; Canadian gas; producer revenues under suspension; producer costs; taxes under cost regulation; and favored nations contract provisions. However grave individual issues may be, public interest centers on adequacy of supply. Producer prices must provide incentive for exploration and development at a high level to induce supplies sufficient to meet demands. Any real uncertainty with respect to future supply caused by a slacking off of exploratory efforts of producers could precipitate a major financial crisis for pipelines and raise gas prices. This increase in pipeline prices would not be associated with an increase in supply; it would reflect only a more rapid pipeline investment payout.

Competition

Fueloil Industry Threatened by a Proposed Change in the Income Tax Law. W. L. Henry. *Fueloil & Oilheat 19,* 56 (1960) Feb. (2 pp.).

Proposed bill in Congress would increase tax on income from crude oil at the wellhead by about 75 cents/bbl. Article points out that if this increase was shared equally between the heating oil and gasoline cut of the barrel, prices for these products would rise

about 3 cents/gal. Users of heating oil and residual fuel could conceivably convert to alternate fuels, which would bring a substantial improvement in coal, gas and electricity competitive position. Also, reduced drilling would cause dwindling reserves.

Oil, Gas Finds Boost Alaska Exploration. *Petrol. Week 10,* 25 (1960) Jan. 22 (3 pp.)

Drilling has been stopped, for the moment, in the three-well Kenai gas field, the first commercial gas field in Alaska. Resumption hinges on the need for additional gas production. Last October's discovery on the 55,000-acre unit flowed at a rate of 31-million CF/day. The three wells fulfill gas-delivery commitments to Anchorage Gas Corp., which recently obtained a franchise to distribute natural gas in Anchorage and adjacent areas. Further drilling will depend on Anchorage Gas' ability to use additional gas, or to develop additional markets.

Oilheating Sales up 12%. *Fueloil & Oilheat 19,* 57 (1960) Jan. (8 pp.)

Total sales of automatic heating—oilburners, stokers and gas burners—all were up in 1959. Aggregate sales totaled 1,987,252, divided: oilburners, 637,057, an increase of 12%; stokers, 12,200, up 0.8% and gas burners, 1,336,995, 15% greater than 1958 sales. However, total sales in 1959 were 11% below the last ten-year average of 716,671 installations and 7.3% below the post war average of 686,953 units.

Drilling

Well Completions Show 3.6% Gain. *Oil Gas J. 58,* 148 (1960) Jan. 25 (6 pp.).

Total completions in the U. S. in 1959 numbered 50,893. This was an increase of 1,782 wells and 3.6% compared with a total of 49,111 wells for 1958, the year that total completions fell below the 50,000 mark for the first time since 1953. Individual 1959 totals show: crude—25,379; condensate—1,255; gas—3,761; dry—19,101; service—1,397; and total footage—208,249,518.

Foreign Activities

Australia Needs Oil. *Oil Gas J. 58,* 134 (1960) Jan. 18 (5 pp.)

Australia has every resource it needs to become a great industrial nation, except oil and gas. Multimillion-acre exploration permits have been granted, at no cost except obligation to explore the blocks which are leased. The government claims royalty of 10%. Large cash subsidies are paid to support drilling. For example, Delhi-Frome-Santos group received a subsidy of $716,000 toward the cost of its first well. It will receive $337,500 toward its second well, now on the way down. With all this encouragement from the Commonwealth government, the oil companies are responding with men, material, and money.

Developments in Town Gas Production. G. Milner. *Gas J. 301,* 102 (1960) Jan. 20; *Gas World 151,* 212 (1960) Jan. 30 (9 pp.)

Future development of British town gas should bring: 1) reduction in the cost of gas production by the concentration of gas manufacture into large stations; 2) development of processes capable of making use of cheaper raw materials such as the smaller sizes of lower rank coals, and at the same time being able to make use of whatever hydrocarbon feedstock might be available; 3) location of larger manufacturing stations, either close to the large ports, or in the centers of coal fields; and 4) development of a British national gas grid.

Pipe Shortage Slows Russian Projects. *Oil Gas J. 58,* 62 (1960) Jan. 18.

Shortage of large-diameter pipe is forcing the Russians to delay some of their pipeline projects, but construction during the early 1960's still will be at a record pace. Production from Soviet pipe mills is covering only 75-80% of requirements. Lag between supplies and needs is expected to continue despite goals of the present seven-year plan calling for a doubling of pipe production between 1959-65. An estimated 3,550 miles of pipe will be laid in 1960, including 2,273 miles of gas lines.

LPG-Production

Gas-Liquids Output Hits All-Time High. *Oil Gas J. 58,* 178 (1960) Jan. 25. (2 pp.)

Booming sales of LPG pushed production of liquids to an all-time high in 1959. Total production at natural-gasoline and cycling plants averaged 36,728,000 gal/day in 1959, compared with only 33,916,000 gal/day in 1958—a gain of 8.3%. LPG represents 58.3% of 1959 total production of liquids produced at natural-gasoline and cycling plants, compared with 54.8% in 1958 and only 36.1% in 1949.

Maintenance

Maintenance Supervisor's Handbook. *Petrol Refiner 39,* 116 (1960) Jan.; **The Maintenance Organization.** F. L. Evans, Jr. *Ibid.,* 116 (7 pp.); **Planning and Scheduling.** *Ibid.,* 122 (8 pp.); **Preventive Maintenance.** *Ibid.,* 129 (7 pp.); **Inspection.** *Ibid.,* 135 (7 pp.); **Keeping Cost Records.** *Ibid.,* 141 (6 pp.); **Turnarounds.** *Ibid.,* 147 (6 pp.); **The Instrument Department.** *Ibid.,* 152 (5 pp.); **Maintenance Painting.** *Ibid.,* 156 (3 pp.)

Direct labor usually accounts for between 40-50% of the total maintenance costs. Eight article series is devoted to managing the maintenance department to get the most of the labor force.

Oil Gas

Third Onia-Gegi Plant Planned for Japan. *Gas World 151,* 146 (1960) Jan. 16; *Gas J. 301,* 117 (1960) Jan. 20.

Osaka, Japan, is the site selected for installation of an oil gasification plant which will eventually be the largest of its kind in the world. By the end of 1960, four units each making 5 MMCF/day of town gas will be in

operation. The total cost of this installation, to be built by Humphreys & Glasgow, Ltd., London, will be about $2 million. Eventually further units will be added to bring the total capacity of the plant to 30 MMCF/day.

Pipeline Construction

Banner Year Seen for Pipelining. *Oil Gas J. 58,* 184 (1960) Jan. 25 (2 pp.)

This is the 1960 outlook, based on reports of what operating companies expect to construct: U. S. natural gas—13,550 miles compared with 13,500 miles in 1959; U. S. crude—1,100 miles compared with 1,900 miles in 1959; U. S. products—3,000 miles compared with 1,300 miles in 1959; Canadian natural gas—1,100 miles compared with 950 miles in 1959; Canadian crude—600 miles compared with 280 miles in 1959; and foreign —5,600 miles compared with 6,700 miles in 1959.

Pipeline Outlook for 1960 Is Good. J. H. Williams. *Oil Gas J. 58,* 78 (1960) Feb. 8.

Another 10,000-mile-plus year was recorded in 1959 by members of the Pipe Line Contractors Assoc. Construction was broken down as follows: natural-gas transmission, 6,957 miles; natural-gas gathering, 732 miles; natural-gas distribution, 1,107 miles; crude trunk lines, 547 miles; crude gathering, zero miles; products lines, 864 miles; and water lines, 56 miles. Outlook for 1960 is good, if fair prices continue.

Promotion

The Milwaukee Story. G. Tolman. *Gas Heat and Comfort Cooling 11,* 29 (1960) Feb. (4 pp.)

Milwaukee Gas Co.'s new policy of going after the heating load to get it sooner is paying off in the heating and gas business. For the former, it has brought increased volume by concentrating on the replacement market, has resulted in comfort-conscious consumers by selling both price and comfort, and has developed sales-conscious dealers. To the gas business, the Milwaukee program has brought gas-loyal heating men, good gas unit performance, and thorough market knowledge.

Safety

Adsorption of Halogenated Fire Extinguishing Agents on Powders. (Tech. Report R-51) A. J. Barduhn, B. S. Patel, W. Meyer and B. B. Smura (Washington: Nat. Aero. and Space Admin., 1960) 62 pp.

The amounts of four different Freons adsorbed by carbon, silica gel, alumina, and molecular sieves were determined at pressures up to 225 lb/sq in. The carbon adsorbed 50-100% and the silica gels, 30-50% of their own weight of Freon. Several adsorbed systems were tested in a standard dry-powder extinguisher on a 5 sq ft gasoline fire for their effectiveness in putting out a fire. One of the Freons (bromotrifluoromethane) and carbon extinguished fires about as well as bicarbonate powder and nitrogen.

How Can We Help Prevent Trailer Fatalities? *Butane-Propane News 22,* 27 (1960) Feb. (5 pp.)

At least 16 persons are dead because faulty heating equipment was installed in travel trailers. While not legally liable, LPG men have a moral obligation to do what they can to prevent the use of improperly designed or installed equipment. Article states that greatest responsibility of LPG man is to press for a long-range solution. The issue of unsafe equipment should be kept alive. Influence must be exerted upon state bodies, trailer manufacturers, court owners, and anyone else in a position to establish and enforce good safety regulations.

2. ENERGY SUPPLY AND ECONOMICS

Natural Gas Reserves

Gas Reserves Are Lagging Consumption. *Oil Gas J. 58,* 158 (1960) Jan. 25 (2 pp.)

Marketed production of natural gas showed a 6.7% gain over 1958. Average annual increase during the past 11 years was 7.9%. However, proved gas reserves only went up 2.6% and their rate of progression in the same 11-year period was 3.7% yearly. At the present rate of gas consumption (11.7 trillion CF) our reserves will last only 22 years at the present figure of 260.7 trillion CF. In 1949, reserves at the rate of consumption then represented almost a 33-year supply. Conclusion: more gas must be found to satisfy future anticipated needs.

Coal

Slurry Pipeline Transportation. E. J. Wasp and P. A. C. Cook (assigned to Consolidation Coal Co.) U. S. 2,920,-923 (1960) Jan. 12.

In transporting a water slurry of coal by pumping through a pipeline over distances of over ten miles, prevention of settling and plugging is claimed by first pumping water, then a slug of psuedo fluid with greater suspending power than water, then the coal slurry followed by a second slug of the psuedo fluid and finally the driving water. The psuedo fluid is a 35-40% weight suspension of coal ground to size of 90% minus 100 mesh Tyler screen, or may be 1-1.5% carboxymethylcellulose, or starch or gelatin solution.

Electricity

Gas vs. Electricity as a Fuel. Part I. *Air Eng. 2,* 20 (1960) Jan. (4 pp.)

Article presents factors which influence choice of electrical or gas-fired heating systems. This first of a series takes up study of two new buildings by a consulting engineer comparing gas vs. electricity. Because of lower initial operating costs, both buildings (church and school) installed gas system. Future article will present the case for electricity in commercial, institutional, and industrial buildings.

Methane

Power from Sewage Methane. *Fuel Efficiency 8,* 27 (1960) Jan.

A new 252 million dollar development of self-sufficient power from sewage methane in Britain is one of the most modern sewage-treatment plants in the world. Area covered is approximately 112 sq miles, with a population of about three million people. Expected yield is 2.5 million CF/day. Plant layout and operation of turbine units are described.

Oil Shale

Bureau of Mines Gas-Combustion Retort for Oil Shale. R. O. Dannenberg and A. Matzick. U.S. Bur. Mines Rep. Invest. 5545 (Washington: U.S. Govt. Print. Off., 1960) 73 pp.

This is a study of the effects of the process variables on retort operation, product yields, and product properties. Statistical methods were used to design the experiments and analyze the effects of the rate of shale throughput, the composition of dilution gas, the height of the shale bed above the air entry, air-gas distributor design, shale size range, and the ratios of the flow rates of the various gas streams entering the retort to the rate of shale throughput. All process variables examined had a significant effect upon one or more of the product properties or retort operating characteristics.

Tar Sands

Drive Begun to Produce Tar Sands. *Petrol. Week 10,* 9 (1960) Jan. 15 (3 pp.); **Four-Company Team Tackles Athabasca.** *Oil Gas J. 58,* 44 (1960) Jan. 18 (2 pp.); *Chem. Eng. 67,* 53 (1960) Feb. 8.

New mining equipment, new process equipment are producing oil in a research project aimed at making Athabasca tar-sand production commercial. Basic extraction process uses a diluent, produced from the bitumen itself, to reduce the viscosity and specific gravity of the bitumen. Water is then used to establish a continuous phase in the water film surrounding the sand particles.

Treatment of Bituminous Sands. J. E. Sherborne (assigned to Union Oil Co.) U. S. 2,291,010 (1960) Jan. 12.

Mined tar or oil sands are pulped with sodium silicate solution and hydrocarbon solvent at 250°F in a rotary-kiln type treater, the pulp separated in a vertical zone in which the sand falls through upflowing fresh solution and the liquid decanted from the separator is held in a quiescent stratifying zone, from which the oil layer is drawn for distillation, and the aqueous layer is desilted and recirculated.

Thermoelectric Power

Producing High Voltage, AC or DC, from Heat. *Gas Age 125,* 32 (1960) Jan. 21. (3 pp.)

International Telephone and Telegraph Corp. gives details of new development, based on the known phenomenon that the permittivity or dielectric constant of certain ferroelectric materials varies with temperature. Ferroelectric converter opens new vistas for distribution of natural gas as the ideal heat source. Basic circuit consists of an initial priming battery, connected in series with a holding diode and a capacitor, which has a dielectric consisting of suitable ferroelectric material such as barium titanate. This capacitor is maintained in charged condition by the battery at the voltage setting of the diode. If the capacitor is then cooled from a high (Curie) temperature to a lower one, its capacitance falls, and the voltage rises by a factor depending on the ratio of dielectric permittivities of the titanate at low and high temperatures. Thus the energy is increased by the same factor, and at sufficient stepup of voltage can pass the diode to operate a connected load. Cascading several stages in a rotating heated and cooled assembly will yield high voltages in DC or AC current.

3. NATURAL GAS AND PETROLEUM PRODUCTION

Drilling

Costs Can Be Cut in Texas, Louisiana. R. J. Enright. Part 1. *Oil Gas J. 58,* 41 (1960) Jan. 18. (3 pp.); Part 2. *Ibid.,* 124 (1960) Jan. 25 (3 pp.)

Operators in Texas and Louisiana say there are many costly faults in the regulatory systems of the two states. Biggest fault stems from the allowable systems. Both states encourage drilling unneeded wells to get higher allowables. Second problem in Texas is the small-tract exceptions rule. Exceptions to field spacing rules allow drilling on tracts too small to accommodate a rig, which oil men claim drains adjacent large acreages.

Standard Rig Used to Drill 46-Inch Holes. G. M. Wilson. *World Oil 150,* 85 (1960) Feb. 1 (4 pp.)

With modifications of existing rig tools and techniques, and outright designing and fabrication of hitherto nonexistent casing handling equipment, a Wilmington, Calif. company drilled two 46-in. holes to depths of 930 and 1,432 ft for uranium mining operations. Unusual feature of equipment was a device for supporting the bit in the conductor pipe below the derrick floor and at a level that permitted easier handling of the tool joints. Nine illustrations show specialized equipment used.

Drilling, Air

Air Drilling Boosts Compressor Use. *Petrol. Week 10,* 21 (1960) Jan. 29 (3 pp.)

Air/gas drilling with the accompanying increase in the use of compressors, has become one of the outstanding technological changes in the domestic drilling industry in recent years. Heaviest concentration of compressors used for domestic drilling (U.S. and Canada) is contained in a 300-mile-wide strip across North Texas, Oklahoma and eastern Arkansas. The next heaviest concentration is in the Rocky Mountain area. West Texas and Canada are roughly tied for third.

Drilling, Mud

Gel Development in Drilling Fluids. F. W. Jessen and C. N. Toktar. *Petrol. Eng.* (Drilling and Producing) *32*, B-48 (1960) Feb. (2 pp.)

Clay suspensions used as drilling fluids exhibit widely varying thixotropic properties. An instrument is described that presents a possible means for determining yield point of drilling muds and measuring rate of development of gel strength.

Thinning Agents Control Flow Properties of Mud. W. C. Browning. *World Oil 150*, 94 (1960) Feb. 1 (6 pp.)

Purposes of thinner in drilling fluids: reduces viscosity and gelation of muds, enabling more solids to be incorporated before the mud becomes objectionably thick; reduces the rate of filtration because of deflocculation of the clay; enables the density of the mud to be increased by addition of barite without the need for dilution with water; and stabilizes the flow properties of mud to counteract the effect of electrolytes encountered in the formation drilled.

Exploration

Discovery of World's Largest Gas Field Is Prelude to a Chain of New Strikes for the Panhandle. K. Chasteen. *Oil Gas J. 58*, 327 (1960) Jan. 25 (3 pp.)

During 1959, the exploratory-well success ratio for the Panhandle-Hugoton area ranged from month to month at a high rate of 40-60%. This was achieved even though the Palu Duro and Raton saw many new tests with no discoveries. This average is more significant when compared with the overall U. S. wildcat success ratio of 1:12. Author expects development drilling to continue at high level during 1960.

Geology

How Measuring Paleosalinity Aids Exploration. A. F. Frederickson and R. C. Reynolds, Jr. *Oil Gas J. 58*, 154 (1960) Feb. 1. (4 pp.)

One of the environmental parameters of biological and geological interest is the salinity of the sea. A method for determining paleosalinities would provide valuable information in the search for various types of mineral deposits and petroleum. Purpose of article is to summarize geochemical work, started in 1956, that was designed to detemine paleosalinities quantitatively by making appropriate measurements on sedimentary rocks. Conclusions: 1) boron content in brines increases with salt content; 2) boron is extracted from sea water by clay-mineral illite in proportion to the amount of boron present; and 3) illites extracted from sedimentary rocks from a wide range of geological environments indicate that their boron content can be used to evaluate the relative salinity of the sea at the time the sediment was formed.

Petroleum Geology. K. L. Landes (2nd ed.; New York: John Wiley & Sons, Inc., 1959) 442 pp; $9.50.

In this second edition, author emphasizes the interrelationships between geology and petroleum production. Applications of geologic principles in oil finding, drilling and production, as developed to date are comprised in the first four chapters. Included is a full treatment of techniques of data gathering, structure studies and uses in map-making. The remaining eleven chapters deal with the occurrence of petroleum, bringing up to date the geologist's views on origin and evolution, and the processes of accumulation which depend upon the fluids, the reservoir rock, the sealing rock and the trap. The latter is treated in five separate chapters each devoted to a particular type of trap structure. Copious references are given for each chapter.

Logging

Fundamentals of Electric Logging. *Petrol. Eng.* (Drilling and Producing) *32*, B-26 (1960) Feb. (9 pp.)

Electric logging services are designed to economically provide geologists and petroleum engineers with data they require for the location, evaluation, and production of petroleum reservoirs. Electric log, and fundamentals of its interpretation are described. Expressions are given for determining relationships between resistivity and porosity of a formation, which in turn convert electrical log data to reservoir rock and fluid data. Porosity determination devices are discussed, and logging programs are given. Included in article is a 30-item bibliography.

Sonic Log and the Delaware Sand. (Tech. Note 2054) M. L. Millican. *J. Petrol. Tech. 12*, 71 (1960) Jan. (5 pp.)

A method of log interpretation is developed in the Delaware sand whereby the effects of the shale contained within the sand can be recognized and accounted for in a quantitative solution for porosity and water saturation. Both theoretical and empirical considerations are discussed. A simplified interpretation chart is presented which provides a means of amending the conventional porosity resolution of the Sonic log to compensate for the presence of shale. An approximation of permeability which may be derived empirically from the chart is presented. The discussion is illustrated by field examples.

Petroleum Production

Here's How to Improve Your Gas Lift Installations. Part 7. How to Select Surface Controller Pilots for Special Gas Lift Applications. H. W. Winkler. *World Oil 150*, 89 (1960) Feb. 1 (5 pp.)

In some gas lift installations, the difference between satisfactory and unsatisfactory operation is dependent upon the type of surface equipment used to control injection gas. There are many types of time cycle, pressure control and combination time cycle pressure control pilots which can be used to operate the motor valve on the injection gas line. Article recommends and describes surface injection gas control equipment for several types of gas lift installations.

Pipeline Construction

Pipeliners Fight Snow, Cold Weather to Lay Big Gas Line. P. Reed. *Oil Gas J. 58*, 70 (1960) Feb. 8 (2 pp.)

Under Alpine and Arctic conditions, contractors are pushing ahead with construction of Transwestern Pipe Line Co.'s big-inch gas line to California. So far, 628 miles of line has been welded for the whole 1,750-mile project. Completion date is set at July 1.

Reservoir Engineering

Calculation of the Exhaustion of Petroleum Deposits in the Presence of Dissolved Gases. M. D. Rosenberg. *Trudi Vses. Neftegaz. N.-i. In-ta,* 250 (1957) No. 10 (7 pp. Russian text); [From *Appl. Mech. Rev. 13,* 73 (1960) Jan.]

Paper is an exposition of the theorem of the approximate integration of the relationship between pressure and petroleum saturation at the boundary of a stratum in the presence of gas in the latter, for the case in which the volumetric coefficient of the petroleum is not constant, as has been assumed in earlier works by the same author, but is a function of the pressure.

V. A. Arkhangel'skii
Courtesy Referativnyi Zhurnal, USSR
Translation, courtesy Ministry of Supply, England

The Methodology of the Hydrodynamic Analysis of the Yield of Accompanying Gas in Conditions of Gas Saturation. M. D. Rosenberg, L. A. Zinovieva and G. V. Klyarovsky. *Trudi Vses. Neftegaz. N.-i. In-ta,* 257 (1957) No. 10 (10 pp. Russian text); [From *Appl. Mech. Rev. 13,* 73 (1960) Jan.]

A method is described for calculating the yield of the accompanying gas from deposits containing dissolved gases, starting from a given (at any time) withdrawal of the petroleum; in the suggested method, the equation of the petroleum balance is applied, with a condition linking the average petroleum saturation of the stratum with the average pressure therein, varying during the process of extraction. This condition is obtained as a result of numerical integration of the relationship between the averaged values of saturation and pressure in the manner suggested by M. D. Rosenberg (see preceding review).

V. A. Arkhangel'skii
Courtesy Referativnyi Zhurnal, USSR
Translation, courtesy Ministry of Supply, England

Petroleum Yield from Strata with a Gas Cap with or without Pressure Applied to the Gas. V. P. Gusseinov. *Trudi Azerb. N.-i. In-ta po Dobytche Nefti,* 127 (1955) No. 2 (9 pp. Russian text); [From *Appl. Mech. Rev. 13,* 74 (1960) Jan.]

The balance equations are given for the discharges of gas and petroleum, as well as the ratio between mean saturation of the porous space by petroleum and the mean pressure in the extraction of deposits with a gas cap. Curves are plotted for the mean weighted pressure values and the gas factor in relation to the degree of petroleum saturation, at different values of the ratio of pore volume within the region of the gas cap to the pore volume in the petroleum-bearing part of the deposit.

V. L. Danilov
Courtesy Referativnyi Zhurnal, USSR
Translation, courtesy Ministry of Supply, England

Tensammetry: Key to Reservoir Wettability Studies. R. A. Todd and G. W. Crawford. *Petrol. Eng.* (Drilling and Producing) *32,* B-74 (1960) Feb. (4 pp.)

Natural surface active agents in oil field brines and crudes sometimes have a marked influence on reservoir wettability. Tensammetry, a method of measuring surface phenomena by A.C. current, is described. Results of tests of fluids from various fields are given.

Well Practice

Technique of Minimum Rate of Flow Tests and the Study of Production Performance. *J. Petrol. Tech. 12,* 23 (1960) Jan. (5 pp.)

Minimum rate of flow is that rate of flow preceding the rate at which the well begins to give definite signs of flowing pressure establishing a downward trend to zero. Required twenty-four hour test data, in the form of recorded wellhead flowing pressures, oil production, salt water production, and gas production, are discussed. Method of completion, electric log and core analysis, method of operation, etc. are described. Examples of different minimum rates of flow tests conducted by the author, with results, are outlined along with concluding information based on results and experiences of well testing.

4. GAS CONDITIONING AND LPG RECOVERY

Coal

Chemical Structure and Properties of Coal XXV — The Carbonization of Coal Models. P. M. J. Wolfs, D. W. van Krevelen, and H. I. Waterman. *Fuel 39,* 25 (1960) Jan. (14 pp.)

Model substances, prepared to imitate the structure of coal, were synthesized by condensation of formaldehyde with substituted and nonsubstituted hydrocarbons. Use of radioactive formaldehyde enabled the carbon percentage present in bridge structures in the synthesized product to be determined in a very simple manner. Course of the carbonization was followed by both a radiochemical and a thermogravimetrical method. Results demonstrate that the primary carbonization is in fact a depolymerization with simultaneous disproportionation of the aliphatic hydrogen. When the starting product contains hydroxyl groups the depolymerization is partly displaced by a dehydration and concomitant condensation. During the secondary carbonization the aromatic hydrogen is released. The information thus obtained facilitates an adequate explanation of the rheological behavior during the carbonization process.

Mechanisms of Coal Pyrolysis. Part I. On the Nature and Kinetics of Devolatilization. N. Berkowitz. *Fuel 39,* 47 (1960) Jan. (12 pp.)

Analysis of the kinetics of weight loss curves measured at a series of constant temperatures leads to the conclusion that these curves do not reflect a protracted thermal decomposition of coal. Instead, it is suggested that they are governed by a rate-determining diffusion

process and that the decomposition reactions at any one temperature must be relatively fast. This hypothesis is tested against a simple theoretical model and shown to be in good agreement with experiment.

A Study of Coal by Mass Spectrometry. H. W. Holden and J. C. Robb. *Fuel 39,* 39 (1960) Jan. (8 pp.)

Behavior of coal samples ranging in carbon content between 82-94% has been studied by heating them at the entrance of the ionization chamber of a mass spectrometer. In the range 80°-450° C the most plainly identifiable products evolved (apart from water, carbon monoxide and carbon dioxide) were methane and alkyl-substituted benzenes, naphthalenes and phenols. The temperature-dependence of the evolution of these compounds and of the broad band of material of molecular weight 250-700 can be correlated with phenomena observed in the early stages of coking. The spectrometer modifications and computation procedures are outlined.

Dehydration

The Glycol Dehydrator. G. Mapes. *World Oil 150,* 51 (1960) Feb. 1 (8 pp.)

Advantage of glycol type well stream dehydration units: 1) low installation cost; 2) operating costs are comparable with other types of dehydrators; 3) pressure drop through unit is low (5-10 psi); 4) high gas inlet temperatures (up to 140°F) can be handled easily; 5) low pressure gas streams easily processed; and 6) economic means of achieving moderate dewpoint depressions when only moderate depressions are required. Equipment used in connection with glycol process is illustrated. Three types of regeneration systems used in glycol dehydrators (open atmospheric, closed atmospheric and vacuum types) are described.

The Short Cycle Hydrocarbon Recovery Unit. R. W. Scott. *World Oil 150,* 59 (1960) Feb. 1 (11 pp.)

Many producers are now using short cycle unit to dehydrate field gas streams and to recover heavy hydrocarbons which previously were lost into sales gas line. Not only does the unit provide adequate sales gas dehydration, but also additional liquid hydrocarbon recovery will pay out the cost of equipment relatively soon. Advantages and disadvantages of method are discussed. Flow diagrams of units equipped with open and closed regeneration gas systems are illustrated. Basic components of the short cycle unit are presented. Included in article are two tables listing unit operational difficulties, and total hydrocarbon recovery (C_1 to C_6+). At inlet flow rate, there was 0.33 mole % of iC_5+/MCF) of gas entering unit. Approximately 2.4 bbl/MMCF or 76% of inlet pentanes plus fractions were recovered.

Dust

Gas Handling System. R. G. Streuber (assigned to Research Corp.) U.S. 2,920,715 (1960) Jan. 12.

A collecting duct divided horizontally by a slotted plate is used to collect boiler flue gases in the lower pass and direct the gas flow to dust cleaning equipment in the upper pass. A mixing chamber located centrally of the length of the duct provides change of direction in flow, without right-angled bends or baffles, thereby reducing pressure losses, dust dropout and size of duct.

Gasoline

Gasoline Hydrocarbon Separation Recovery Process Utilizing Molecular Sieves. G. F. Feldbauer, Jr., C. E. Jahnig and Weinstein, N. J. (assigned to Esso Research and Eng. Co.) U.S. 2,920,038 (1960) Jan. 5.

A separation process for gasolines is claimed wherein straight-chain paraffin hydrocarbons are removed selectively by adsorption on molecular sieves while other olefin and nonparaffins pass through unabsorbed. Improved regeneration of sieve zone is obtained by displacement of paraffins with propylene gas at reduced pressure, and on resumption of paraffin adsorption, said propylene is recovered by scrubbing with a wash of nonparaffin product.

Hydrogen Sulfide Removal

Hydrogen Sulfide Desorption from NaCl Brine. L. W. Piester. *Chem. Eng. Progress 56,* 65 (1960) Jan. (3 pp.)

Design of commercial unit was based on mass transfer data developed from experimental equipment. Sulfide removal was satisfactorily accomplished in the scaleup. The overall liquid phase mass transfer rate was calculated from the driving forces at top and bottom of tower (Henry's Law) and plotted for liquid rates. The tower design was then calculated.

New Potassium Carbonate Process. J. A. Goolsbee and H. K. McLaughlin. *Petrol. Refiner 39,* 159 (1960) Jan. (2 pp.)

A new process for the simultaneous removal of CO_2 and H_2S from natural gas to pipeline specifications. Previously used amine cleanup section is eliminated, resulting in lower investment and lower operating costs. Flow scheme and pilot plant data are presented, with additional information coming in future article.

Conversion of Hydrogen Sulfide into Free Sulfur. R. A. Feagan, Jr. (assigned to Pan American Petroleum Corp.) U.S. 2,919,976 (1960) Jan. 5.

Sulfur is recovered from a gas containing 10-15% hydrogen sulfide by the reaction of a H_2S-SO_2 mixture in a catalyst zone at 400°-500° F. One third of the H_2S is burned by controlled air injection to form the SO_2 and maintain the conversion temperature, first in boiler condenser, and then in subsequent catalytic converters, also provided with air injection and sulfur condensers.

Removing Hydrogen Sulphide by Liquid Purification. A. R. Myhill. Part 1. *Gas J. 301,* 22 (1960) Jan. 6 (4 pp.); Part 2. *Ibid.,* 68 (1960) Jan. 13 (4 pp.)

Technique is particularly applicable to newer methods of gas manufacture which operate at high pressures.

Bulk of the H_2S can be removed by simple water-washing under prevailing high pressure in the plant; final removal being effected by iron oxide. Complete removal may be practicable by employing irreversible absorption process without the necessity of oxide catch box. Part 1 gives basic principles, reactions and flow diagrams of the Manchester process and Perox system, with costs and advantages of each. Part 2 studies the following processes: W-D-Koppers vacuum carbonate system; washing with compounds of zinc; processes operating under high pressure; and the removal of H_2S and recovery of sulfur with an organic oxygen carrier.

Organic Sulfur

Purification and Properties of Ten Organic Sulfur Compounds. J. C. Morris, W. J. Lanum, R. V. Helm, W. E. Haines, G. L. Cook and J. S. Ball. *J. Chem. Eng. Data 5,* 112 (1960) Jan. (5 pp.)

Article reports physical properties (density, refractive index, viscosity, surface tension, melting point, cryoscopic constant, and boiling point), reference spectra, and thermodynamic properties for the following high-purity sulfur compounds: methanethiol, 1-propanethiol, 2-methyl-1-propanethiol, 2-methyl-2-butanethiol, 1-hexanethiol, benzenethiol, 1-heptanethiol, 2-thiahexane, 4-thiaheptane, and 5-thianonane

Separators

The Ammonia Absorption Refrigeration Unit. J. R. Heumann. *World Oil 150,* 70 (1960) Feb. 1 (7 pp.)

Purpose of ammonia refrigeration unit is to furnish refrigerant for low-temperature separation. Ammonia is absorbed in water, which is pumped into a still column where the ammonia is distilled and condensed. Flow diagram of compression and absorption refrigeration cycles is illustrated. In addition to the chiller, the ammonia absorption unit consists of the ammonia absorber, still charge pumps, feed-bottoms heat exchanger, ammonia still, still reboiler and ammonia condenser. Process characteristics and equipment design as suited to field conditions are discussed. Present and possible future applications are presented.

5. NATURAL GAS TRANSMISSION

Automation

Current Status of Pipeline System Automation. R. F. Williams. *Gas Age 125,* 20 (1960) Feb. 4 (4 pp.)

Pipeline system components which are operated automatically at this time are discussed. Examples of these are flow controllers, pressure controllers, and various safety devices. If a pipeline system is to become completely automated, an electronic computer would be necessary to coordinate these components.

Communications

Pipeline Communications Data. L. E. Cook. *Pipeline Eng. 32,* H-45 (1960) Feb. (3 pp.)

When preparing estimates or specifications for communications system of a pipeline, engineer's choice will be influenced by immediate costs, costs over a long period, availability of facilities, reliability of service need, flexibility of later expansion, and management policies. The following types of facilities are described, and their uses are listed: 1) microwave, 2) VHF radio, 3) pole and/or open wire lines, and 4) leased circuits. Characteristics and costs for each are listed.

Compressor Stations

More Gas Pipeline Muscle per Dollar. G. T. Kinney. *Oil Gas J. 58,* 120 (1960) Jan. 25 (2 pp.)

Trunkline Gas Co. proposes to achieve a sharp reduction in compressor-station costs with two small, lightweight, ultra high-speed gas turbines operating in the 20,000-rpm range. Neither type has been proved in gas-transmission service. If either machine is found experimentally sound, there will be: much greater use of gas turbines, which already are becoming an important factor as a driver of centrifugal compressors on long gas lines; and reduced capital cost of installed horsepower which will enable pipelines more economically to expand by building low-cost boosters between existing stations.

Pipeline Controls Data. *Pipeline Eng. 32,* H-49 (1960) Feb. (14 pp.)

Four basic control operations are involved to properly control a station: (1) control of prime mover, (2) control of line valves (positioning), (3) alarm notification (abnormal conditions), and (4) shutdown protection (to prevent damage to equipment). A tabulated control check list is given. Among the thirteen appended graphs and tables included horsepower required to compress natural gas, piston displacement in CF for various diameters and strokes, equilibrium moisture content of natural gases, volume of crude or gas required to fill a pipeline, and volume change vs horsepower change.

Compressors

Here's An Easy Approach to Centrifugal-Compressor Selection. S. L. Cole. *Oil Gas J. 58,* 107 (1960) Feb. 8 (4 pp.)

Article provides a method of finding "first approximation" of a centrifugal compressor for a contemplated service which does not introduce such factors as impeller polytropic efficiency, mechanical and thermodynamic loss, exponential calculations, and "Mu" factors. Data presented permit approximating: compressor-shaft brake horsepower at coupling; number of stages; discharge temperature; and speed.

Why, Who and How to Specify Centrifugal Compressors. H. Q. Duguid. *Refining Eng. 32,* C-13 (1960) Feb. (4 pp.)

Fundamental principle behind any procurement specification is maximum return on the purchaser's invested capital. A centrifugal gas compressor must be so speci-

fied that the compressor procured will effectively handle gas compression job and that plant investment will yield a maximum return. Procurement follows three basic steps: purchaser requests quotations, reviews various offerings, and jointly prepares a construction specification covering equipment capable of meeting operation and maintenance requirements.

Meters

Sizing and Selecting Orifice Meters. H. M. Camish. *Pipeline Eng. 32,* H-62 (1960) Feb. (5 pp.)

For computing volume of natural gas passed through an orifice meter, the A.G.A. Gas Measurement Comm. Rep. No. 3 is the accepted standard. Graphs accompanying article present information in a simplified and accurate form, by graphically relating capacity to meter tube size, orifice diameter, and flowing pressure with graphic corrections for gas temperature, specific gravity, and supercompressibility. Graphs cover 4-30 in. metering tubes, flowing pressures from 0-1000 psia, flowing gas temperatures from 20°-100°F, specific gravities from 0.56-0.70, and supercompressibilities from 1.00-1.12. Two examples showing the use of the graphs are given.

Pipeline Construction

Designing Pipelines for Simultaneous Flow of Oil and Gas. *Pipeline Eng. 32,* H-67 (1960) Feb. (14 pp.)

Design procedure is applicable to flow lines from wells to separators, condensate and oil field multiphase gathering lines, and other pipelines involving the simultaneous flow of a liquid and a gas phase. One two-phase pipeline usually costs less than two single-phase lines, one for oil and one for gas. In addition, maintenance costs, investment in separate handling facilities, and operating labor is reduced. Multiphase pipelines have been favored in difficult terrain such as offshore, marsh, or desert conditions. About one-half of all gas gathered in the U. S. flows through two-phase pipelines to the gasoline plant or central separator stations. U. S. investment in two-phase pipelines is estimated as greater than one billion dollars. Operating characteristics, flow patterns, pressure drop equations, and examples of calculation procedures in multiphase designs are given.

Europe's Pipeline Network. *World Petrol. 31,* 56 (1960) Jan. (2 pp.)

Europe is expanding its pipeline network rapidly as energy use rises and oil's share increases. Article gives pipeline table showing the owner, route, completion date, length, diam, capacity, annual throughput and commodity carried for the following countries: Algeria, Austria, Belgium, France, Germany, Italy, Morocco and Netherlands.

French Plan Line from Big Algerian Gas Field. *Oil Gas J. 58,* 82 (1960) Feb. 1.

French expect to start construction within the next few months on a 24-in. pipeline to carry the gas north from the big Hassi R'Mel gas field to both Algiers and Oran. They have already landed 54 miles of the 327 miles of pipe needed at the Algerian port of Mostaganem. They started trucking more than 40 miles of this initial pipe supply south more than 100 miles to Tiaret almost immediately. French hope ultimately to be able to ship the vast gas supplies into European markets, but until technical problems of crossing the Mediterranean are licked, gas will be used in North Africa.

Gas Transmission Piping System Standards. Extracted from Oil Transportation Piping Code (ASA B31.8—1958), Amer. Standard Code for Pressure Piping. New York: Amer. Soc. of Mech. Eng.); [*Pipeline Eng. 32,* H-27 (1960) Feb. (18 pp.)]

Code covers the design, fabrication, installation, inspection, testing, and safety aspects of operation and maintenance of gas transmission and distribution systems, including gas pipelines, gas compressor stations, gas metering and regulating stations, gas mains, and gas services up to the outlet of the customer's meter set assembly. Also included within this section are gas storage equipment of the closed pipe type fabricated or forged from pipe or fabricated from pipe and fittings, and gas storage lines.

Handling Propane by Pipeline. F. B. Neptune. *Pipeline Eng. 32,* D-19 (1960) Feb. (5 pp.)

Considerable interest is presently being manifested in handling LPG in pipelines as a result of the recent increase in LPG marketing. Volume has doubled in the last eight years, and reached approximately seven and a half billion gallons in 1958. Pumping characteristics are discussed. When pumping LPG through the same lines with distillates, especially if internal scale exists, care must be taken to provide suitable buffers to prevent contamination. Tankage should be provided by the shipper. If the pipeline has to provide storage, tariffs would be higher to pay for this expensive storage. Underground storage in caverns developed in salt strata or mined in suitable limestone or shale can be used.

Oil Transportation Piping System Standards. Extracted from Oil Transportation Piping Code (ASA B31.4—1959), Amer. Standard Code for Pressure Piping. New York: Amer. Soc. of Mech. Eng.); [*Pipeline Eng. 32,* H-1 (1960) Feb. (27 pp.)]

Code is applicable to design, selection of materials, fabrication, inspection and testing of liquid petroleum pipeline transportation systems. These systems include all piping carrying crude oil, petroleum products, and liquefied petroleum gas between producers' lease tanks, terminals, refineries, natural gas plants, and other delivery and receiving points. Also included are liquefied petroleum gas storage facilities of the closed pipe type, fabrication from pipe and fittings, and lines interconnecting these facilities.

Pipeline River Crossings. M. L. Pentzien. *Gas Age 125,* 17 (1960) Jan. 21 (4 pp.)

An analysis of a typical crossing of a major river, with particular attention to: the wet or river ditch, which may require special planning; the pipe work or bank

operation; and the actual installation, which offers a choice of ramp, pull, or stove-pipe. Effect of local conditions upon these three major factors is discussed.

Seismic Analysis—New Technique for Solving Ditching Problems. *Am. Gas J. 187,* 29 (1960) Feb. (3 pp.)

New seismic analysis technique offers quick, easy and inexpensive method of determining whether sub-surface material can be cut by the trencher or whether it must be ripped by a tractor-ripper unit, or blasted. Equipment includes a source of sound or shock wave, a receiver, an electric counter, and a set of tables. One model, which sells for about $3000, includes the electronic counter, housed in a small metal container, a geophone that plugs into one receptacle on the counter's face, and a long wire that plugs into another receptacle with the other end connected to a spring contact switch on the sledge. Knowing the time of wave travel and distance from the hammer to the geophone, the depth, density, and wave velocity can be determined with two given formulas.

Detergent Cleaning of Pipelines. J. N. White and A. Bartoszek. *Gas Age 125,* 30 (1960) Feb. 4 (5 pp.)

Authors describe the results Panhandle Eastern Pipe Line Co. has obtained by cleaning pipelines with various detergents—soap and water, gasoline, and alkali and water. Although the detergents have so far been efficient for lengths as great as 40 miles, they have proved to be no more expensive than wire brush cleaning. Future use of the detergent and brush methods in the same cleaning operation is indicated.

Pipeline Operation

Digital Computer Applied to MCF-Mile Study. F. M. Jessup and R. Adams. *Gas 36,* 97 (1960) Feb. (6 pp.)

Southern Natural Gas Co.'s transmission system consists of two multiple-piped mainlines about 70 miles apart, paralleling each other for about 330 miles. Each line receives its supply from different areas. Delivery is effected through an intricate system of branch lines supplied from either mainline. The main problem, finding the average number of miles for each MCF of gas transported from supply to delivery, is now programmed for the IBM 650 digital computer. One complete set of calculations can be compiled with 18 minutes. Article discusses the entire operation of programming, with a description of a study being directed toward having the 650 compile the delivery volume directly from sales information.

First Computerized Gas Dispatching System. B. Karcher, and H. Jacobson. *Am. Gas J. 187,* 21 (1960) Feb. (4 pp.)

The first computerized system ever used in on-line gas dispatching control is being used by Public Service and its subsidiaries to monitor gas flow meters at purchase points throughout the greater Denver area and the state of Colorado. The system, utilizing a Libratrol-500 computer system, calculates the total hourly and accumulated demand for each hour of the day. Primary advantage is that system permits control decisions to be made at rates that match the time constants of the process and system involved. Hardy Cross technique is used in the analysis and design of the gas distribution system.

6. GAS AND LPG STORAGE

Gas Holders

Considerations, Studies and Experiences in the Statics of Water-Sealed Gas Holders. E. Caffo and C. Padovani. *Rivista dei Combustibili 13,* 769 (1959) Nov. (27 pp. Italian text)

Annular structure of the joint between the crown and the top curb of the inner lift sheetings plays an all-important role in the statics of water-sealed gasholders; it is there that the severest stresses engendered by the weight of the gasholder, the gas pressure, and incidental loads are all concentrated. The 130,000 m^3 (five million CF) capacity gasholder, with an average diameter of 200 ft. comes into the large capacity range. A detailed, thorough study is given of the crown support design, of some parts of bearing framework and adjacent areas of sheeting which are involved in the effort condition in the annular area most severely stressed. Detailed investigations were made in the statics of large capacity gasholder crowns, based on a theoretical approach different from that usually adopted. Experimental methods are discussed for checking deformation, safety, and stress characteristics as previously computed and determined in the specifications.

Wiggins Holders Are Storing a Wide Range of Gases. *Gas Times 94,* 18 (1960) Jan. (3 pp.)

Simplicity of design and ability to give uninterrupted service under most stringent conditions with minimum maintenance are chief characteristics of this versatile gasholder. Since the first unit—of 10,000 CF—to be erected in this country was installed at Alston for the Northern Gas Board in 1952, more than 70 have been supplied to the gas and chemical industries and to the British Atomic Energy Authority at capacities of 50-500,000 CF. Gases stored in holders include town gas, argon, methane, sewage gas, nitrogen, helium and sulfur dioxide.

LPG Storage

Alabama Gas Uses Large Volume Refrigerated Storage. T. G. Humphreys, J. and F. A. Faulkinberry. *Gas 36,* 49 (1960) Feb. (5 pp.)

Alabama had been peak shaving in Birmingham, using a propane-air plant and stored gas from several holders. New plant at Birmingham is located on a 55-acre tract of land. Plant has a basic design sendout capacity of 18 MMCF/day of a 1350 Btu/CF propane-air mixture, at delivery pressure of 160 psig. In natural gas equivalent, this amounts to approximately 23 MMCF/day. Liquid propane storage is about 1.44 million gas. in three Hortonspheres. Plant is designed and laid out so that production capacity may be increased 50% by adding units to the original installation. Space is available to increase storage facilities by adding more spheres.

How Northern States Power Saved More than $50,000 by Installing 90,000-Gallon Propane Tank. J. C. Simandl and W. Peters. *Gas 36,* 60 (1960) Feb. (3 pp.)

In 1958, the capacity limits of containers for storing liquefied petroleum gas at utility gas plants went from 30,000 to 200,000 standard U.S. gal. A study by Northern States Power Co. found that major cost advantages can be had with a reduction in number of individual tank accessories, valves, gauges, platforms and ladders, tank piping and foundations. Total saving by substituting four 90,000-gal. tanks for twelve 30,000-gal. tanks was estimated in excess of $50,000.

Underground Storage

The Question of Underground Gas Storage in Europe. Part 1. Technical possibilities. *Gas J. 301,* 98 (1960) Jan. 20 (5 pp.); **Part 2. Economic Problems.** *Ibid.,* 142 (1960) Jan. 27 (4 pp.)

A digest is given of the report of UN Economic Comm. for Europe on Gas Problems which discusses the need for storage in the growing utility gas industry of Europe. Operating reservoirs now storing coke oven and refinery gases are discussed in detail, and planned storage for natural gas is presented. Beynes, Vernon and Lussagnet in France, Engelbostel and Reitbrook in Germany, Rostocki in Poland and Buguruslan in USSR are described with comments on capacity, supply and sendout, and estimated costs of operation. In Part 2, economics are further developed with data on Beynes; it is emphasized that economics depend upon the individual reservoir and its consumption system, with regard to factors of consumption, size, location, and security of supply.

Royal Dutch/Shell in Methane Tie-Up. *Gas J. 301,* 111 (1960) Jan. 20.

Interests of the Royal/Dutch Shell group of companies, Continental Oil Co., and the Union Stockyards & Transit Co. of Chicago, in the liquefied natural gas field are to be developed through the medium of a jointly-owned company to be known as "Conch International Methane Ltd."

7. MANUFACTURED GAS AND CHEMICAL PROCESSING

Acetylene

Acetylene/Ethylene from Naphtha. M. J. Barry, J. M. Fox, S. S. Grover, F. Braconier, and P. Leroux. *Chem. Eng. Progress 56,* 39 (1960) Jan. (8 pp.)

The Societe Belge de L'Azote—Kellogg processes for acetylene/ethylene by pyrolysis of natural gas and naphtha are described. The special burner and operating procedure are discussed together with data on different raw material and on products under varying operating conditions. Purification system and use of liquid ammonia as selective solvent for acetylene are explained.

Acetylene/Ethylene via Thermal Cracking. J. M. Reid and H. R. Linden. *Chem. Eng. Progress 56,* 47 (1960) Jan. (6 pp.)

Acetylene impurities can be economically removed from olefin stream by use of selective solvents. Where acetylene concentration is high, this process can be adapted to recover the acetylene as a product. Product gas composition was nearly independent of feed properties. With increasing effective reaction temperatures, the acetylene concentration passed through a maximum and the ethylene and methane decreased. Acetylene maximum, 12-14 mole percent, occurred at 1800°F and ½ atm.

Carbonization

Desulfurizing Low Temperature Char. Rate and Total Inhibition Data in Batch Systems. Rate Data in a Continuous System. J. D. Batchelor, E. Gorin, and C. W. Zielke. *Ind. Eng. Chem. 52,* 161 (1960) Feb. (8 pp)

Rate of desulfurization of low-temperature char is strongly dependent upon temperature and H_2 pressure and is severely depressed by H_2S. More precise data were needed to define the kinetics of the char-solids reaction. Inhibition observed with H_2S can be treated as a pseudoequilibrium process. Isotherms are defined which give the point of total inhibition as a function of gas and solids composition. Low-temperature char is very readily desulfurized in a continuous unit. The process is rate-controlled at pressures below three atm but controlled by "equilibrium" in the char-H_2S reaction at higher pressures.

An Economical Char Process . . . How Soon? L. Berg and D. E. Atkinson. *Chem. Eng. Progress 56,* 73 (1960) Jan. (5 pp.)

Design and results for three-ton/day char-making pilot plant at Montana State College (Bozeman, Montana) are described. Data for several western intermountain coals and their chars and volatiles are given. A larger demonstration plant, now inactive, was operated at Red Lodge, Mont.

New Coking Methods Shorten West's Raw Material Supply Lines. *Chem. Week 86,* 40 (1960) Jan. 16. (3 pp.)

Two new carbonization processes for producing metallurgical grade coke from Utah and Wyoming low-grade coals are in planning stage, to satisfy fuel demand for phosphorus blast furnaces. These include: Food Machinery and Chemical Corp. $3.5 million plant at Kemmerer, Wyo.; a metallurgical coke plant at Pocatello, Idaho; and U.S. Fuel Co. pilot plant at Salt Lake City. These could also supply the phosphorus operations of Monsanto Chemical at Soda Springs, Idaho and Victor Chemical at Silver Bow, Mont. now on expensive Eastern coke.

Ethylene

High Purity Ethylene via the Solvent Extraction Route. H. C. Schutt. *Chem. Eng. Progress 56,* 53 (1960) Jan. (7 pp.)

Acetylene removal by extraction with acetone at low temperature represents an economical process (operat-

ing cost: 0.165 ¢/lb of ethylene). Application in comparison with catalytic hydrogenation of acetylenic impurity should be investigated in the planning stage of an ethylene production project. Author suggests that selective absorption can also be applied to a propylene product for the removal of methylacetylene and propadiene. If CO_2, which is usually present in the C_3 fraction, is also to be removed, then acetone may not be the solvent to use, since its selectivity between CO_2 and C_3H_6 is small.

Gasification

Coals for Complete Gasification. *Gas Times 94,* 15 (1960) Jan. (3 pp.); *Gas World 152,* 172 (1960) Jan. 23 (4 pp.)

Coal industry's serious economic problem in Great Britain can be solved on a short term basis by the increased utilization of small coal. Author discusses coal needs of the Lurgi and the Gaz Integrale processes. Among his observations of the Lurgi project: contrary to popular belief the Lurgi plant cannot produce synthesis gas from all grades of coal, and it cannot be used in connection with a Fischer Tropsch unit to produce valuable hydrocarbons from otherwise unusable low-grade fuels.

Apparatus for Gasification of Finely Divided Solid or Liquid Fuels. A. Klapp and B. Zellerhoff (assigned to Koppers Co., Inc.) U. S. 2,919,980 (1960) Jan. 5.

In a pressure-oxygen coal gasification apparatus, a safety feature is claimed which provides an inert gas (nitrogen) purging in the event of electric power failure to the main blower. A system of nitrogen purging lines to the gasifier, and holder supply of nitrogen is provided, with a high-pressure nitrogen tank to supply an injector-aspirator arranged for action by a magnetic, pressure-actuated valve.

Processes for the Production of Combustible Gases. F. Totzek (assigned to Koppers Co.) U. S. 2,920,945 (1960) Jan. 12.

A fuel gas generating process is claimed in which powdered coal is injected with oxygen and steam (or CO_2) into two or more conically shaped refractory reaction zones which are attached tangentially to a central cyclone chamber in which the endothermic gasifying reaction is complete, gas is withdrawn axially upward, and solid residue withdrawn downward.

Nitrogen Oxides

Fixation of Atmospheric Nitrogen in a Reciprocating Compressor. R. D. Smith. *J. Appl. Chem.* 10, 1 (1960) Jan. (5 pp.)

Equations are presented for the formation of nitric oxide by the adiabatic heating and cooling of air in an idealised reciprocating compressor without heat loss. Equations are integrated numerically to find the effect of engine speed, compression ration and starting temperature on the yield. Experiments with preheated air in an engine run as a compressor show that nitric oxide can be formed in this way, but in much less than the theoretical amount, owing to heat losses. Maximum proportion of nitric oxide obtained in pure air is 0.6%; in air containing 50% of argon, it is 2.7% (relative to air). Nature of discrepancy between theory and experiment indicates that there are important temperature gradients in the cylinder charge of gas.

Oil Shale

Composition of Low-Temperature Thermal Extracts from Colorado Oil Shale. W. E. Robinson and J. J. Cummins. *J. Chem. Eng. Data 5,* 74 (1960) Jan. (7 pp.)

Samples of raw oil shale were extracted with Tetralin at 25°-350°C for 24-144 hr. As a result, kerogen was degraded to a soluble material, with production of no or very little pyrolytic gases at 300°C, and only about 6% of kerogen was degraded to gases at 350°C. There was no evidence of the formation of carbon residue at any temperature. Crude extracts were fractionated into oils, waxes, resins, and pentane-insoluble material and were characterized by ultimate analyses, ring analyses, X-ray diffraction, mass and infrared spectra, and chemical treatment. Study showed that the composition of the extracts depended upon the time and temperature of extraction.

Ore Reduction

Economic Aspects of Direct Reduction of Iron Ore in Illinois. W. H. Voskuil and H. E. Risser. Circular 283. (Urbana: Illinois State Geological Survey, 1959).

Direct reduction of iron ore by one or more processes under study by steel companies will not displace the blast furnace but should supplement or complement ore reduction by blast furnaces. Direct-reduction plants will be developed in locations where small-scale local production is desired but coking coal is not available, or where costs are high. Direct reduction may be used to increase the capacity of either old or new plants to produce material that can be substituted for scrap iron in the charge to the open hearth furnace or to enrich a normal blast furnace charge. It may be used near a market and where ore and coal can be assembled cheaply, conditions that are especially favorable along the waterways in Illinois.

New: Making Iron in a Fluidized Bed. *Chem. Eng. 67,* 96 (1960) Feb. 8 (4 pp.)

The H-Iron process has come to commercial use in a $3.8 million, 50 ton/day plant at Conshohocken, Pa. Unit, now in preliminary operation, will produce a high quality iron powder for powder metallurgy applications. Distinguishing feature of H-Iron process compared to other fluid-bed processes is the high operating pressure (500 psig) which permits a high rate of reduction at low temperatures. Hydrogen for the reducing reaction is produced by partial oxidation of coke oven gas which comes from nearby coking operations. Production rate amounts to about 1.2 million CF/day of hydrogen. To make a ton of H-Iron powder requires 1.4 tons of iron ore along with 20,000-22,000 CF of H_2, 0.25 tons of O_2, 100 lb of N_2 plus steam, cooling water and electric power.

Iron Ore Reduction Process. J. W. Halley (assigned to Inland Steel Co.) U.S. 2,919,983 (1960) Jan. 5.

A balanced process for reducing iron oxide ore and melting the reduced iron is claimed, comprising a three-stage operation including 1) a hearth or melting zone heated by coal-oxygen burners to melt metal generated and hot combustion gases, 2) a reforming zone to raise reducing capacity of hearth combustion gas by a steam-carbon reforming reaction, and 3) a reduction zone where fine iron ore is contacted at 900°-1800°F with the reducing gas in a moving bed. Separate adjustment of carbon and oxygen supplied to the separate zones permits balancing of chemical and heat requirements to give efficient, coordinated operation of all steps.

Method of Operating a Gas Generating Shaft Furnace as a Gas Generator, Blast Furnace or Cupola, and a Furnace For Carrying the Method into Effect. N. R. Wahlberg (assigned to Axel Arne Severin, Sweden) U.S. 2,919,185 (1959) Dec. 29.

A combined gas generating and ore smelting shaft furnace is claimed, comprising two superimposed chambers, a top-fed reducing zone and a bottom melting zone. Coal is fed to the top and fine ore is fed annularly around the coal, the two descending in an expanding "inverted bosch" for a short distance to meet a downwardly directed annular blast of hot air, which partially burns and carbonizes the coal without tar formation. At a slightly lower level, a second annular air blast gasifies the coke, further reduces the ore to a lumpy sponge, and excess gas is then withdrawn at the widened section of the shaft. The downward-moving lumps of sponge are completely reduced in the lower narrowing shaft and are then melted in the bottom chamber by a third annular air blast, to form casting metal and slag.

Petrochemicals

ICI Commissions Third Olefine Plant at Wilton. C. W. Wood. *World Petrol. 31,* 44 (1960) Jan. (4 pp.)

New unit by Imperial Chemical Industries' Heavy Organic Chemicals Division boosts ethylene capacity 60% to a total of 110,000 tons, and olefin capacity to 230,000 tons. Outstanding feature is incorporation of a battery of 15 free-piston gas generators, each producing the equivalent of 1,000 shaft hp and supplying hot gas into a ring distribution which feeds six expansion gas turbines driving the six centrifugal compressors, totaling about 14,000 hp.

Method and Apparatus for Cracking Hydrocarbons. E. S. Pettyjohn, H. R. Linden, and J. M. Reid (assigned to Institute of Gas Technology) U.S. 2,921,100 (1960) Jan. 12.

Method and apparatus are claimed for a cyclic regenerative process for cracking hydrocarbons up to Bunker "C" oil to form gas products rich in acetylene and ethylene. This includes two regenerators with one end of each connected to an elongated reaction chamber. Superheated to above 2000°F, a rapid stream of steam and air receives an injected spray of hydrocarbon at one end of reaction chamber, passes through in 0.1 second or less and is quenched immediately to below 1000°F. Yields of above 40% ethylene and acetylene are obtained.

Petroleum Refining

Petroleum Processing. Principles and Applications. R. J. Hengstebeck. (New York: McGraw-Hill Book Co., 1959) 348 pp. $10.00.

The increased demand for petroleum products has justified improved and diversified production methods. This book may be considered to be an outline, for the technical reader, of the many processes and techniques required to produce the major products from a complex raw material. Processes are discussed in groups according to their general usage. Author presents a clear description of the principles, equipment, controls and chemistry involved in bulk production of gasoline, distillate fuels, and lubricants. Chief physical process of separation—distillation—is discussed, followed by a description of absorption, stripping, extraction, adsorption and crystallization. Fundamental reactions of the following chemical conversion processes are described: pyrolysis, thermal and catalytic cracking, reforming, polymerization and alkylation, isomerization, hydrogenation, lube oil and wax processes, and clay and hydrogen treating. Each is treated in a separate chapter, with copious modern references.

Producer Gas

Anthracite Gas-Producer Tests at a Brick Plant. R. F. Tenney, J. D. Clendenin, and W. S. Sanner. *U.S. Bur. Mines Rep. Invest. 5556* (Washington: U.S. Govt. Print. Off., 1960, free)

Results are presented of investigations of 1) standard anthracite-gas producers, and 2) anthracite producer-gas-fired periodic kilns. Descriptions of producer and periodic-kiln equipment, operating procedures, and labor requirements are given. A summary of the conditions of producer and kiln operation is presented for a two-week observation and data taken for the previous 11 months.

Radioactivity Applications

Scavenger Studies in the γ-Radiolysis of Hydocarbon Gases at Very Low Conversions. R. A. Back. *J. Phys. Chem. 64,* 124 (1960) Jan. (4 pp.)

Experiments at very low conversions, using ethylene or propylene as scavengers for hydrogen atoms, indicate that about two-thirds of the hydrogen produced in the γ-radiolysis of ethane, propane, n-butane and n-pentane, in the gas phase, arises from hydrogen atoms. This is considerably higher than indicated from previous studies at higher conversions, and it is suggested that unsaturates produced in the radiolysis acted as internal scavengers in the latter systems, thus reducing the apparent yield of radical hydrogen. Kinetic evidence is presented indicating that the unsaturates used as scavengers removed hydrogen atoms by a simple addition reaction and did not interfere in other states of radiolysis.

8. GAS DISTRIBUTION

Dust

The Collection, Monitoring and Identification of Particles in Gas Distribution Systems. A. W. Doyle, W. J. Smith, N. M. Wiederhorn. A.G.A. Project PF-15 (New York: Amer. Gas Assoc. Catalog No. 46/OR, 1959) 145 pp. $3.00.

When excessive amounts of solid and liquid particles are contained in utility gas distribution systems, they can erode component parts, reduce flow in narrow orifices, cause valve sticking, etc. resulting in increased maintenance and service costs. Report presents the research done on analytical techniques which are needed to determine particle size and concentration in order to insure proper corrective measures. Description and uses are given of the following four instruments which were found to be of particular value to the gas industry: the cascade impactor, millipore filter, thermal precipitator, and the absolute filter.

Particulate Dynamics Research at Sandia Laboratory. J. R. Banister. Proc. 6th Midwest Conf. Fluid Mech., 277-91 (Austin, Texas: Univ. of Texas Press, 1959); [From *Appl. Mech. Rev. 13,* 71 (1960) Jan.]

Paper presents conservation of mass, momentum and energy equations in differential form for flow of air with suspended dust particles. The mass of suspended dust per unit volume is comparable to the density of air, and the dust particles are assumed to be of identical size. After indicating the complexity of the problem if dust-air interaction and particles of different size and shape are present, an approximate solution for one-dimensional flow near a stagnation point is developed. These equations form the basis for the construction of probes for measuring air dynamic pressure and dust momentum flux. Accurate measurements were obtained for particles greater than 20 microns in an air stream of several hundred ft/sec, while a 25% error was found in dust momentum flux for particles of about 10 microns.

K. Schneider, USA

Leakage

Know Your Gas Piping. J. Lee. *Gas Heat and Comfort Cooling 11,* 38 (1960) Feb. (4 pp.)

Article describes general procedure of following gas leak complaints. Initial call is usually made on a "make-safe" basis only. Final disposition depends entirely on the location and nature of the leak. Tests of new piping are discussed. Exact methods of how to locate and repair a leak in a pipe are described. Threaded joints, sand holes at fittings, and flexible connectors used on appliances are a few of the more vulnerable locations were leaks can occur. Twelve preventative measures to avoid leaks are given.

Mains

Plastic-Coated Pipe Installed at High Speed. *Gas 36,* 71 (1960) Feb. (2 pp.)

Tough, plastic-coated steel pipe has been installed at Fredricksburg, Va. at about 20 times the speed it took to lay the cast iron pipe it replaced. New pipe was laid at the rate of 8000 ft/day and often was horizontally jacked or pushed through unbroken ground. It was possible to weld a bullhead to the leading end of pipe lengths, and literally ram them into place by jackhammer, 20-30 in. below the surface. As much as 180 ft of pipe, welded together, was installed at the same time. Time and labor involved in tearing up the earth and then replacing it again was eliminated. Customers also were pleased that their lawns were not disturbed.

Metering

Telephone Reading of Industrial Gas Meters. *Gas Age 125,* 19 (1960) Feb. 4.

Northern Illinois Gas Co. will give telephone reading of gas meters a test under working conditions during 1960. The method, developed for reading 60 industrial meters, which require servicing seven days a week, may also be applied someday, to reading residential meters.

Odorization

Apparatus for Odorizing Liquefied Gas. J. B. Calva. U.S. 2,919,981 (1960) Jan. 5.

A device for odorizing liquefied cylinder gases is claimed, which comprises an enlarged chamber in the outlet valve fitting, a cartridge of capillary material designed to be saturated with odorant (mercaptans), inserted into chamber at each fresh filling with fuel, and a plastic seal over the threaded end of the fitting designed to be broken when cylinder is connected into the users piping. A slow leakage of gas is likely to pick up more odorant from the cartridge, and provides more ready detection.

Odorizing Unit. R. M. Hutchison, U. S. 2,921,844 (1960) Jan. 19.

An odorizing unit comprising odorant storage tank, connected to float-valve controlled gas-bubbling chamber, where odorant seal is maintained, and the saturated gas is returned to high pressure line. An additional injection of liquid odorant is provided by pressure-controlled valves.

Pressure Regulation

Planning, Prefabrication, and Salvage in Key Shop Operation Helps Cut Costs. D. Rains. *Am. Gas J. 187,* 32 (1960) Feb. (2 pp.)

Article describes the operation of the regulator and pipe shop of Washington Gas Light Co. The shop helps cut paperwork and time in field operations through various prefabricated assemblies that it furnishes, helps cut waste through an efficient salvage program, and provides a maintenance program for regulators.

Recommendations for the Maintenance of Governors Used for Gas Distribution. D. D. Melvin. Comm. No. 539. London: Institution of Gas Engineers, 1959.

Recommendations for the maintenance of all pressure

governors and diaphragm-type volumetric governors and associated governor equipment are given, including pressure-operated holder valves, but not including appliance governors. Precautionary measures to be taken prior to dismantling a governor are discussed. Included in the appendix are maintenance report sheets given to workman to take on the job.

9. GAS FUEL UTILIZATION AND APPLIANCES

Air Conditioning

Ion Generator Increases Utility of Air Conditioner. *Appliance Manuf. 8*, 53 (1960) Jan. (3 pp.)

All of Philco's 1960 models of air conditioners will accommodate an Ionitrol, a device which generates negative ions for the air conditioned space. Conventional air conditioning depletes these ions. An abundance of them reduces air-borne allergies, and adds to the general feeling of well being and comfort. Ionitron operates whenever the air conditioner fan is running.

Air Pollution

Photooxidation of Hydrocarbons in Mixtures Containing Oxides of Nitrogen and Sulfur Dioxide. E. A. Schuck and G. J. Doyle. (San Marino, California: Air Pollution Foundation Rep. No. 29, 1959) 90 pp. $3.00.

This third technical report presents data on the photochemical reaction between oxides of nitrogen and various pure hydrocarbons found in exhaust gases and between oxides of nitrogen and selected solvents. The foundation draws the following conclusions from the data presented: (1) probable eye irritants in photochemical smog are formaldehyde and acrolein; (2) these aldehydes are formed only from olefinic hydrocarbons; and (3) paraffinic and aromatic hydrocarbons are not involved to any appreciable degree in the production of smog manifestations. Accordingly, the authors state that Los Angeles-type smog can be eliminated by drastic curtailment of atmospheric olefins.

Burners

Burner. J. B. Henwood and S. C. Wood (assigned to Selas Corp.) U. S. 2,920,691 (1960) Jan. 12

In a pressure burner for premixed gas and air, a metal spherical shell pierced with a multiplicity of small orifices is surrounded by a larger spherical casing to form a manifold with the two shells joined eccentrically at a round orifice common to both. The manifold is fed by supply tubes welded near the orifice and bent downward around outer sphere to join a common fitting threaded to fuel supply. Combustion occurs within the inner sphere at high rates, and products are projected at large orifice at nearby flame temperature.

Burners for Gaseous Fuel. H. G. Hays and R. L. Wentz (assigned to Armstrong Furnace Co.) U.S. 2,918,967 (1959) Dec. 29.

An improved gas burner for home heating furnaces is claimed, in which an efficient spreading conical flame is obtained by forming an annular flame port at the upper lip of an annular gas-air mixing chamber. The outer cylindrical chamber wall is joined to the customary injector mixing tube, while the upper edge of the inner cylindrical wall is bent outwardly to form a baffle to spread and deflect the flame outwardly. Secondary air enters through the central bottom opening of the inner cylinder, and flows upwardly parallel with the inner face of the flame to give smooth combustion at low noise level.

Fluid Fuel Burner. C. E. Hajny (assigned to Baso Inc.) U.S. 2,920,126 (1960) Jan. 5

A gas burner and a thermoelectric generator are claimed, with a generator output controlled within narrow limits in spite of variable fuel gas pressure. Control is achieved by fixed mounting of burner and thermo-unit, with impingement of burner flame on unit designed to deflect combustion products toward the primary air inlet of burner. At higher gas pressures, the inspirated combustion products soften the burner flame by reducing the fuel-air ratio.

Gas Electric Heating Device. D. W. Scofield (assigned to Philco Corp.) U. S. 2,921,176 (1960) Jan. 12.

A gas pervious or perforated plate of foamed silica insulating material carries an electric resistance wire heater element in a grooved upper surface, which is covered by a silica glass top plate for holding cooking vessels. Gas from a lower chamber passes through pervious plate and is burned flamelessly on catalyst-coated heating coil, with combustion products collected in outer concentric channel connected to vent manifold. Coil current switch and gas shutoff may be cooperative.

Combustion

Method of Combustion for Low-Grade Fuel and Apparatus Therefore. T. Tinker (assigned to American Radiator & Standard Sanitary Corp.) U. S. 2,920,689 (1960) Jan. 12.

For recovery of heat value in lean cupola gases (12-18% CO), the gases under blower pressure are passed to a large separate combustion vessel, where controlled amounts of air are jetted in and ignited in lower and upper mixing zones, and the hot combustion products heat a large built-in exchanger through which the cupola blast air is flowing. Blast temperatures may be controlled by thermostatic regulation of air jet valves.

Cookers

Ford, E. The Socially-Ubiquitous Potato Crisp and How Gas-Fired Equipment Ensures High Quality. *Gas J. 301*, (Gas in Ind. Sect.) 7 (1960) Jan. 6 (5 pp.)

Gas-fired cooking plants are favored by potato chip makers for turning out a product that is attractive and appetizing. Article describes Crimpy Crisps Ltd. plant in England where gas load is 20,000 CF/hr. Entire plant operation is presented, from the initial storage of potatoes at the factory to the final packaging of the cooked chips.

Dryers

Facts You Should Know About Gas Clothes Dryer Exhausts. M. A. Fuller, *LP-Gas 20,* 37 (1960) Feb. (2 pp.)

Objectives of clothes dryers are to expedite vaporization of water, and to assume a low relative humidity at point of introduction of air to the wet fabric. American Standards for clothes dryer installation and operation are discussed. Standards prohibit connection of clothes dryer exhaust to chimneys or gas vents because it may reverse the flow of other gas appliance connectors causing draft hood spillage. Also, fires may occur in the chimney or vent from deposition of lint.

Flame Research

Combustion of Cyanogen with Endothermic Oxides of Nitrogen. C. S. Stokes, R. P. M. Werner, W. F. R. Smith and J. A. Cahill. *Ind. Eng. Chem. 52,* 75 (1960) Jan. (4 pp.)

Combustion of cyanogen and nitrous oxide, nitric oxide, and nitrogen dioxide was studied, and the stoichiometry of the nitric oxide was verified experimentally. Theoretical flame temperatures of cyanogen and oxides of nitrogen were calculated. Burning velocity was measured as a function of temperature for the oxy-cyanogen flame and as a function of concentration for cyanogen and the oxides of nitrogen.

Furnace

Gas Fired Furnace Plant for Power Station and Nuclear Equipment. Part 1. *Gas 23,* 9 (1960) Jan. (6 pp.)

Kinds of factory gas furnaces are described which are used in the manufacture of pressure vessels, superheaters, heat exchangers, headers, manifolds, pipes, etc. Among these: stress relieving and annealing furnaces (operating at 600°-650°C); heat treatment furnaces (915°-920°C); and portable cover annealing furnace (680°-950°C).

Ventilation

Hygienic Controls of Combustion in Domestic Gas Appliances. M. Boselli, L. Finzi, A. Castiglioni, G. Mangano, and G. Moravia. *Rivista dei Combustibili 13,* 795 (1959) Nov. (43 pp. Italian text)

Hygienic combustion control is discussed from the standpoint of ventilation of living premises. Assuming that the appliances meet official standards, a ventilation rating guaranteeing healthy living conditions must be determined. Charts and formulae are given for computing the CO_2 accumulating in a room according to ventilation and time. Example charts are given showing particular operating conditions of an instantaneous water boiler without exhaust pipe, working alone or at the same time as a kitchen appliance.

10. EQUIPMENT AND INSTRUMENTATION

Computers

Systems Engineering. T. J. Williams. *Chem Eng. 67,* 121 (1960) Feb. 8.

Advantages are presented of systems engineering over conventional methods. Article details differences in procedures, necessary new information, required tools and the actual increases in return on investment from the systems-designed plant. Specific uses, and graphs which show the growth of analog and digital computers are presented.

Gas Turbines

Power's First Gas-Turbine Operating-Cost Survey. *Power 104,* 67 (1960) Feb. (3 pp.)

Results of worldwide survey of operating costs of stationary gas turbines working in three kinds of service are presented. Returns emphasize versatility of gas turbine and its ability to meet economically a wide variety of situations in a wide variety of geographical locations. Twenty-six plants reported here represent about 20% of the total gas-turbine plants now running. All turbines listed are open-cycle.

Grinding

Process and Apparatus for Comminuting Solid Viscous Substances, with a Liquefied Gas as a Precooling Agent. H. Beike and G. Erberich (assigned to Knapsack-Griesheim, A. G., Germany) U.S. 2,919,862 (1960) Jan. 5.

A low temperature liquefied gas, such as nitrogen or air is used to chill sticky solids or semisolids such as plastics, rubber, asphalts in the claimed apparatus, by maintaining a bath of the chilling liquid, feeding the lumpy materials to the bath, removing chilled lumps by a lift conveyor from the bath to a crushing device, and cooling such device and the crushed product by the cold vapors from the chilling bath.

Heat Exchangers

How to Estimate Heat Exchangers. A. P. Buthod. *Oil Gas J. 58,* 67 (1960) Jan. 18 (16 pp.)

Charts presented can be used for an estimated 90% of the heat transfer requirements of refinery or natural gasoline plant. Nine example problems discuss the following factors: heat balance; mechanical design (including tube sizes, lengths, shell diameters, and tube pitch); basic heat transfer equation; film coefficients; and pressure drop. Included is a 47-item cross section of heat exchange literature.

Instruments

Electronic Instrumentation Finds Favor at Anchor's Tabasco Plant. H. R. Marsh. *Oil Gas J. 58,* 115 (1960) Feb. 8 (3 pp.)

Electronic instrumentation at Anchor Gasoline Corp.'s

Tabasco plant offers centralized control from one location thereby requiring only one operator per shift. Total gas-processing capacity of plant is 40,000 MCF/day. This is a relatively lean gas, having approximately 0.83 gal of C_3-plus fractions/MCF. Liquid end products from the plant are propane, butane, and/or propane-butane mix. Flow diagram of entire process is illustrated. Additional advantages from electronic equipment: no moving parts; interchangeability of components; simple operation and maintenance; comparable costs with pneumatic equipment; and better adaptation to future improvements and computer control.

Metering

Orifice Metering. T. J. Filbran. *Instruments & Control Systems 33,* 116 (1960) Jan. (4 pp.)

Thin-plate, sharp-edged orifice, comprising only a plate with a hole in it, is inserted in the pipe. Factors that affect flow, temperature, pressure, density, and viscosity can be measured. Article develops the solution of flow coefficient, correction factors, and presents metering problems.

Pumps

How to Specify Centrifugal Pumps. W. J. Evers and E. E. Ludwig. *Refining Eng. 32,* C-27 (1960) Feb. (2 pp.)

In specifying a pump, the following must be avoided: pyramiding safety factors by being too generous with design capacity over calculated; control valve pressure drops; friction drops; and rating head over calculated head. Make a tentative selection of a particular vendor, type and model to facilitate checking overloading, standard materials of construction, and other details. From the tentative selection, decide if a vertically-split-case is required. Many of mechanical features of the pump cannot be set until final selection is made.

Operator's Handbook for Gasoline Plants. Part 6. Rotary Pumps. Manuf. Dept. Bay Petrol. Co., TGT. *Petrol. Refiner 39,* 185 (1960) Jan. (10 pp.)

Descriptions are given of the two types of rotary pumps —centrifugal and gear, with installation and operating procedures for both. Information including factory assembly, field installation, pump allignment, various piping instructions, lubrication, priming, pumping, etc. is included, together with a check list for centrifugal pump troubles and causes.

Separators

Investigation of the Work of Centrifugal Cyclone-Separators. P. N. Platonov and N. K. Naremskii. *Trudi Nauchno-Tekhn. o-vo Mukomol. i Krupyan. Prom-sti i Elevat. Kh-va,* 3 (1957) No. 5 (30 pp. Russian text); [From *Appl. Mech. Rev. 13,* 71 (1960) Jan.]

The work of a cyclone was investigated by measuring the hydraulic resistance (the energetic indicator) and the magnitude of the removal of material (the technological indicator). The hydraulic resistance of the cyclone falls with an increase in the concentration of the solid phase. Optimum relation between the diameters of the exhaust pipe and the cylindrical portion was 0.6. Increase in the height of the cylindrical portion reduced its resistance, not influencing the technological effectiveness. Increase of the diameter increased its absolute resistance. A series of empirical relationships is put forward for the determination of the basic dimensions for a centrifugal separator for use in machinery for pneumatic transport.

U. Ts. Andres
Courtesy Referativnyi Zhurnal, USSR
Translation, courtesy Ministry of Supply, England

Standby-Plant

Stand-by Plant Inspection. W. T. Harper, *Gas 36,* 54 (1960) Feb. (6 pp.)

The following nine areas listed should be subjected to regular periodic inspection by an unbiased outside expert: basic plant design, unloading stations, storage tanks, safety relief valves, line valves and regulator stations, vaporizers, gas-air mixing equipment, air compressors and boilers, and general safety. In recent inspection of a stand-by plant, discrepancies were found that could have prevented use of the plant. Article describes specific careless operating procedures that cause loss of time and money.

Temperature Measurement

Errors in Thermocouple Circuits. R. J. Almond. *Instruments & Control Systems 33,* 80 (1960) Jan. (3 pp.)

Major errors are overlooked frequently in the design of thermocouples circuits, generally because of misinterpretation of thermocouple wire guarantees. Errors can accumulate in a thermocouple circuit when junctions between dissimilar metals, including lead-wire junctions and instrument connections, are not at 32° F. Eight methods of improving system accuracy are given.

High-Temperature Measurement. V. G. Shaw. *Instruments & Control Systems 33,* 58 (1960) Jan. (4 pp.)

Four general methods of high-temperature measurement include: thermocouples; total radiation devices; brightness or optical pyrometers; and two-color pyrometers. Advantages and disadvantages of each method are presented.

The Ratio Pyrometer. D. L. Burk. *Instruments & Control Systems 33,* 64 (1960) Jan. (4 pp.)

Basic defect of radiation or optical pyrometers is dependence on emissivity of radiator. The Shaw Ratio pyrometer which is free of emissivity errors under certain conditions is described. An evaluation of the pyrometer is presented, with information on its stability, threshold, response, calibration, warmup, and mill setup.

Surface Temperature Measurement. W. K. Moen. *Instruments & Control Systems 33,* 70 (1960) Jan. (4 pp.)

Observation during high-temperature testing disclosed that with static surface temperature in the 1600°F

range, measurement discrepancies can be as much as 50°F even when reasonable care is taken in the application of measuring devices and in the calibration of recording equipment. With rapid changes in temperature, readings differed occasionally by as much as 150°F, and 15 seconds were sometimes required for equalization. Measurements of higher surface temperatures in laboratory testing requires more of a change in thermocouple design than simply shifting to a wire with a higher temperature rating. Consideration must be given first to the conditions affecting convection when surface temperatures of 1000°F or more are involved. In this range, the investigation disclosed that readings can be altered roughly 50% by changing only the convective conditions.

Thermistors. R. K. Schiff. *Instruments & Control Systems 33,* 83 (1960) Jan.

Interchangeable thermistor elements with stable temperature-resistance characteristics are described, which give high sensitivity and have ability to be designed with sufficiently high resistance values to make lead-resistance errors negligible.

Thermocouple Temperature Measurement without Special Instruments. D. Kelly. *Instruments & Control Systems 33,* 76 (1960) Jan. (2 pp.)

Inexpensive panel meters are described which can be used with thermocouples to give temperature readings which are accurate within 5-10%. Article also presents approximately resistance, per foot, for more commonly used thermocouples.

11. MATERIALS OF CONSTRUCTION, AND CORROSION

Alloys

High-Temperature, High-Pressure Oxidation of Alloys Caused by Carbon Dioxide. J. C. Bokros and W. P. Wallace. *Corrosion 16,* 73t (1960) Feb. (6 pp.)

Data are presented on corrosion of heat resistant alloys by high pressure CO_2. A description is given of oxidation behavior of 26 alloys in 1000-2000 psi CO_2 in temperature range of 1100-1740°F. Oxidation rates of heat resistant alloys in 2000-psi CO_2 at 1300° and 1500°F were very low. In all cases, scales were protective. Oxidation followed a parabolic or slower rate law. At 1740°F, most alloys tested exhibited excessive scaling in 1000-psi CO_2.

Cathodic Protection

Anodic Passivation Studies. J. D. Sudbury, O. L. Riggs, Jr. and D. A. Shock. *Corrosion 87,* 91 (1960) Feb. (8 pp.)

Brief review of present theories of passivity indicates that corrosion can be completely stopped by formation of a very thin oxygen containing film. This concept has not been previously used in practical control of corrosion. Using a potentiostat for maintaining a constant potential of a metal to be protected, many variables involved in the anodic control of corrosion were studied. Electrical measurements show film resistance to be as high as 10^4-10^6 ohms/cm^2. This extremely high resistance allows establishment of protection in very complex geometrical vessels, and even in flow lines. Major achievement is the development of a potential controller which allows metal passivation to become of immediate practical importance. Pilot studies using a 500 gallon 304 stainless vessel filled with 67% H_2SO_4 showed that corrosion could be completely stifled for indefinite periods by application of almost negligible currents. Current and voltage requirements for anodically protecting process or storage vessels are presented.

Control of External Corrosion on TAPLINE. F. M. Maasry. *Pipe Line News 32,* 52 (1960) **Part 1.** Jan. (4 pp.)

The most common means of corrosion control are: application of a suitable protective coating, and supplementary application of cathodic protection. Method used to study the effect of corrosion control for the Trans-Arabian Pipe Line System from Saudi Arabia to Lebanon consists of taking pipe-to-soil potential measurements using a potentiometer and a copper-copper sulfate reference electrode. Areas of faulty coating are pin pointed by conducting surface potential survey with measurements taken every 30 ft on the line. Sudden dips in the pipe potential indicate bad coating or a corroded area. Reconditioning work is based on the results of such inspection.

Use of High Silicon Cast Iron for Anodes. R. J. Emerson. *Corrosion 16,* 109 (1960) Feb. (5 pp.)

Data are tabulated from questionnaire replies received from more than 100 companies pertaining to use of high silicon cast iron for anodes. Of the 230 installations for which data were reported, 53% concerned ground bed applications, 37% fresh water and 10% salt water. In general, data indicate high silicon cast iron anodes are at least equal to graphite anodes in ground bed applications where coke breeze backfill is utilized, and superior in marshland and other areas where backfill is impractical. In fresh water applications high silicon cast iron anodes perform very well so long as the temperature does not exceed 125°F. At high temperatures the molybdenum containing alloy is preferred as is also the case in many brackish or salt water applications where the temperature may exceed 100°F.

Coatings

Advantages of Steel Pipe Coated with Plastic. H. M. McDaniel. *Gas Age 125,* 26 (1960) Feb. 4 (2 pp.)

Article describes changeover to use of hot melt pressure-sensitive adhesive with good electrical and chemical resistance, mechanical strength, low-moisture absorption, resistance to weathering, and relatively high heat resistance. New cleaning equipment had to be installed to grit and shotblast the surface of the pipe. Large adhesive tanks were also installed so that an adequate supply of molten material at the proper temperature

would always be available. The coated pipe is available now has ¾ through 5 9/16 in. outside diam. Production will start soon on sizes to include 6⅝ and 8⅝ in.

Engineering Approach to a Chemical Plant Coating Program. N. D. Casdorph. Parts 1 and 2. *Corrosion 16,* 13 (1960) Jan. (3 pp.); Parts 3 and 4. *Ibid.,* 20 (1960) Feb. (3 pp.)

Part 1 gives specimens of records used in a painting program at a seacoast chemical plant. How these records help the coating engineer keep track of his work, and how they can be used to estimate costs are explained. Philosophy and some subjects covered in a painter education program at a chemical plant are described in Part 2. Part 3 gives the specifications of some of the coatings systems used at a seacoast chemical plant. Results accomplished with these coatings are described. Coatings include vinyls, epoxies, oil base materials, zinc-silicones, and aluminum metallizing. In Part 4, tests are described in which an effort was made to ignite gases from solvents commonly found in coatings. In no case was it possible to ignite the solvents with the sand particles. Sandblast streams played on burning solvents extinguished them. Means are described to prevent sandblasting from causing damage to adjacent operations and to reduce objections by operating personnel to sandblasting.

Asphaltic Coating Composition and Method of Application. D. E. Carr (assigned to Phillips Petroleum Co.) U.S. 2,918,940 (1959)Dec. 29.

A pipe coating material is claimed which comprises 100-300 parts of mineral filler admixed with 100 parts of asphaltic blend consisting of 50-85% asphalt, 10-30% rubber or synthetic polymer rubbers and 5-30% chlorinated (2.5% Cl) polyethylene. Coating is designed for application in a molten extrusion process.

Corrosion

Materials Engineer in the Chemical Industry. Burton, W. H. *Corrosion 16,* 9 (1960) Feb. (3 pp.)

Rapid advances in materials and corrosion and the resulting wealth of knowledge obtained are making possible a more scientifically constructive approach to industry's problems. Many companies now have metallurgical, corrosion or materials engineers employed full time and are obtaining benefits not only in longer equipment life but also in improved process efficiencies. Article shows how the General Chemical Division of Allied Chemical Corp. has set up within a centralized engineering department a materials engineering section. Functions of the section are explained not only within that department but will all other related company problems.

Sources of Underground Corrosion Potential Differences. K. G. Compton. *Corrosion 16,* 87 (1960) Feb. (4 pp.)

Article explains potential of metals in their environments and its role in galvanic corrosion. Sources of potentials discussed include polarization, stray current, dissimilar metals, differences in electrolyte and differences in structure surface. Author also discusses behavior of potentials during corrosion. Tabular data and figures are given.

Inhibitors

Proposed Standardized Static Laboratory Screening Test for Materials to Be Used as Inhibitors in Sour Oil and Gas Wells. *Corrosion 16,* 63t (1960) Feb. (2 pp.)

Description is given of a static laboratory test designed to provide a simple, easily reproducible method for screening materials to be evaluated subsequently as possible inhibitors in sour oil and gas wells. Mild cold rolled steel specimens were immersed for seven days in deaerated brine containing 400-600 ppm hydrogen sulfide plus kerosene. Materials suppressing 90% or more of the weight loss found in the control were deemed to be suitable for further use.

12. ANALYTICAL METHODS AND TESTS

Chromatography

Analytical Accuracy in Gas Chromatography Using Thermal Conductivity Detectors. A. Weinstein. *Anal. Chem. 32,* 288 (1960) Feb. (3 pp.)

Changes in pressure and flow rate upon sample introduction have been ascribed to viscosity differences between carrier and sample. On this basis, only pressure decreases would be expected to occur here. Author states that the observation of both positive and negative changes, and the dependence of the magnitude and directions of these changes on the retention times of the samples indicate that an adsorption phenomenon is primarily responsible for these effects.

Application of Gas Chromatography to Microdetermination of Carbon and Hydrogen. O. E. Sundberg and C. Maresh. *Anal. Chem. 32,* 274 (1960) Feb. (4 pp.)

Technique is based on the combustion of the organic compound to CO_2 and H_2O by a mixture of copper oxide and copper in a helium atmosphere. Water is subsequently converted to acetylene by reaction with calcium carbide, and CO_2 and C_2H_2 are separated by elution through a silica gel column with helium. Separated gas components are detected by thermal conductivity. Concentrations are recorded in terms of peak areas by a strip chart recorder. Analysis is completed by comparing the measured CO_2 and C_2H_2 peak areas with previously established calibration charts of peak areas vs milligrams of C and H_2.

Carbon-Hydrogen Determination by Gas Chromatography. A. A. Duswalt and W. W. Brandt. *Anal. Chem. 32,* 272 (1960) Feb. (3 pp.)

Method developed for the determination of carbon and hydrogen by gas-solid chromatography has a precision to 0.5% absolute for carbon and 0.1% for hydrogen. Time for combustion, separation, and recording of the chromatogram is 20 min. On a continuous basis, a new

sample may be started every 10 min. Compounds containing oxygen, nitrogen, halogens, or sulfur may be run directly without difficulty. Sample size is from 2-6 mg., and might be considerably smaller with more sensitive equipment.

Infrared Spectroscopy

Apparatus for the Determination of the Band Absorption of Gases at Elevated Pressures and Temperatures. J. T. Bevans, R. V. Dunkle, D. K. Edwards, J. T. Gier, L. L. Levenson, and A. K. Oppenheim. *J. Optical Soc. Am. 50,* 130 (1960) Feb. (7 pp.)

Apparatus is described for up to ten atmospheres and temperatures up to 1400° K. An optical path of 15 in. is maintained with an accuracy of 1% by a nozzle seal system which allows measurements to be made without the use of windows in the high temperature zone. Use of KBr windows for the pressure seal permits measurement to 23 μ.

Mass Spectrometer

Qualitative and Quantitative Analysis of Organic Compounds. C. J. Varsel, F. A. Morrell, F. E. Resnik, and W. A. Powell. *Anal. Chem. 32,* 182 (1960) Feb. (5 pp.)

A method which permits qualitative and quantitative analysis of multicomponent mixtures by low-voltage mass spectrometry has been developed. It eliminates 1) the necessity of subtracting components from the spectrum of a multicomponent mixture, and 2) the use of simultaneous equations. Method provides a rapid means of obtaining the molecular weight and ionization potential of an organic compound.

Oxygen

The Conversion of Oxygen in Compounds to Carbon Monoxide for Mass Spectrometric Analysis. I. Lauder and B. Zerner. *Australian J. Chem. 12,* 621 (1959) Nov. (9 pp.)

A method by which oxygen in many organic compounds and some inorganic compounds can be converted to carbon monoxide for mass spectrometric analysis is described. The compound is decomposed in the vapor state in the presence of excess bromine by contact with a clean or a carbon-coated platinum wire at a bright red heat. The bromine acts as a scavanger and removes hydrogen and hydrocarbons. Carbon monoxide is obtained quantitatively and may be isolated in a pure state, except when the compound contains nitrogen, by freezing out the other decomposition products using liquid air. Memory and dilution effects are very small.

The Conversion of Oxygen in Compounds to Water for Isotopic Analysis by a Density Technique. I. Lauder and I. R. Wilson. *Australian J. Chem. 12,* 613 (1959) Nov. (16 pp.)

A method is described which enables oxygen in numerous compounds to be isolated in the form of water as a preliminary step to the determination of the isotope composition of the oxygen by a density technique. Oxygen in the compound is converted to CO or CO_2. These gases are reduced by hydrogen in the presence of a pure nickel catalyst to yield water and hydrocarbons. A small memory effect is shown, but this is eliminated by the first sample put through the process. The process is carried out on a scale such that one mole of water is produced for each reduction. Time involved is about two hours per sample.

Thermal Analysis

An Inexpensive Differential Thermal Analysis Apparatus. W. W. Wendlandt. *J. Chem. Education 37,* 94 (1960) Feb. (3 pp.)

Basic principles, characteristics, and limitations of a differential thermal analyser are described. By use of this technique, the qualitative identification of a compound is possible by determining the temperatures at which endothermic or exothermic reactions take place as the substance is heated. Special low-cost apparatus is described consisting of an easily built furnace and stainless steel sample holder; a motor-driven variable transformer to control the temperature of the furnace; and an inexpensive strip-chart microvolt recorder made from an illuminated D'Arsonval type galvanometer. The operation of the apparatus is completely automatic, and works well in the temperature range from ambient to 800°C.

13. BASIC SCIENCE

Adsorption

Fixed-Bed Adsorption. H. M. Barry. *Chem. Eng. 67,* 105 (1960) Feb. 8 (16 pp.)

Improved designs and calculation methods, new materials put adsorption in the same technical and economical class as distillation, extraction and absorption for the separation of chemicals. Practical information is given on how equilibrium and kinetic data can be used for evaluation and designing adsorption systems, including the novel mass transfer approach. Properties of commercial adsorbents are reviewed. Equipment and process design factors are discussed. Economic comparisons of adsorption and distillation are made.

Carbon

Reactions of Carbon with Atomic Gases. J. D. Blackwood and F. K. McTaggart. *Australian J. Chem. 12,* 533 (1959) Nov. (10 pp.)

Wood chars were reacted at atmospheric temperature with hydrogen atoms, oxygen atoms and carbon monoxide, hydrogen atoms and hydroxyl radicals, produced by the action of a radiofrequency field on H_2, CO_2 and water vapor respectively. Chars were prepared at different temperatures and contained different amounts of O_2. Experimental results showed that the gases must be present in the atomic form before reaction with the carbon can take place and that such species react on the carbon-surface independently of active sites. In normal gasification processes the atomic species appear to be produced at active centers, which for the chars

used could be correlated with specific oxygen groups remaining the carbon. It is suggested that these groupings may have a pyran structure.

Compressibility

Compressibility of Helium-Nitrogen Mixtures. J. E. Miller, L. Stroud and L. W. Brandt. *J. Chem. Eng. Data 5,* 6 (1960) Jan. (4 pp.)

Compressibility factors for the helium-nitrogen system at pressures up to 4000 psia were obtained at 70°F. The parabolic equation $Z = 1 + BP + CP^2$, where Z = compressibility factor (PV/RT), and P = pressure in psia, was fitted to the experimental data by the least squares method. Z factors computed by the equation, at each experimental pressure, using the cofficients obtained, were compared with experimental data and presented in tabular form. This table also includes the percent deviation at each pressure and the average percent deviation for each mixture over the entire pressure range.

Diffusion

Application of the Turbulent Diffusion Laws for Investigation of Scattering of Liquid Streams Out-Flowing from Small Apertures. *Nauchn. Trudi Novocherkasskii Politekhn. In-ta,* 49 (1957) No. 39 (53) (17 pp. Russian text); [From *Appl. Mech. Rev. 13,* 52 (1960) Jan.]

Equations of the turbulent diffusion of the liquid compound in the axisymetrical air stream can be linearized by the partial exchange in the equations of mean-point-values of velocity, by the mean value throughout the cross section of the stream. Equations so obtained are analogous to the heat-convection equations and can be integrated by the conventional means. Theoretical results are compared with experimental data concerning the atomization of fuels. The theory agrees well with experiment in cross sections remote from the pipe outlet where the concentration of the liquid mixture is sufficiently small.

L. G. Loitsianskii
Courtesy Referativnyi Zhurnal, USSR
Translation, courtesy Ministry of Supply, England

Concerning a Turbulent Diffusion in a Stream with a Transverse Gradient of Velocity. E. A. Novikov. *Appl. Math. Mech. 22,* 576 (1958) No. 3 (4 pp.); [From *Appl. Mech. Rev. 13,* 51 (1960) Jan.]

Author discusses diffusion of an impurity from an instantaneous point source and does not extend solution to continuous or area sources. A constant settling speed of the impurity and a linear variation of the horizontal wind with height are considered. By substitution of variables and a Laplace transform the diffusion equation is solved. The solution for the most general case involves a matrix of time-dependent parameters of atmospheric turbulence about which nothing is known. By restricting the solution to a steady-state stream and choosing coordinate axes which correspond to the principal axes of the turbulent diffusion tensor, a manageable expression for the concentration is obtained. This differs from earlier solutions principally in that for long times the concentration decays as the minus 5/2 power rather than as the minus 3/2 power of time.

F. I. Badgley, USA

Distillation

Distillation . . . in View of Modern Developments. K. F. Gordon and J. A. Davies. Part 2A. *Refining Eng. 32,* C-31 (1960) Feb. (3 pp.)

In the design of separation processes such as distillation, it is desirable to know the number of design variables that must be arbitrarily set to fix the whole system. Effect of a change in one or several variables can be determined exactly without undue effort once a computer program is available. Article shows how it is possible to find how many variables in a system are truly independent systematically for distillation colunms and indicates approach for a situation involving a number

Equilibria

Liquid-Vapor Equilibrium in Nitrogen-Helium and Helium-Methane Systems. F. F. Kharakhorin. *Inzhenerno-Fizicheskii Zhurnal 2,* 24 (1959) Sept. (6 pp. Russian text); From *Battelle Tech. Rev. 9,* 25a (1960) Jan.

At pressures of 40-215 atm. the solubility of helium in liquid nitrogen and methane can be calculated with sufficient accuracy from the Krichevsky-Kazarnovsky equation. Constants of equation are found for all temperatures investigated. Volatility of pure He is calculated in the temperature range from 6-160°K at pressures of 300 atm.

Fluid Flow

Fundamental Aspects of Solids-Gas Flow. Part 3. Accelerated Motion of a Particle in a Fluid. L. B. Torobin and W. H. Gauvin. *Can. J. Chem. Eng. 37,* 224 (1959) Dec. (13 pp.)

Analysis of the extensive literature on nonsteady drag forces supports the correlation of the data by means of a total drag coefficient, which appears to be function of the Reynolds number and of a reduced time parameter which is related to the number of particle diameters traversed since the initiation of the motion. The added mass concept is shown to be both completely inadequate and theoretically unsound. An increase in wake turbulence resulting from Reynolds number increases or from the occurrence of surface roughness seems to diminish the acceleration effects. Fundamental studies of the flow fields around blunt bodies reveal the extreme complexity of the phenomena occurring during acceleration. Explanations offered for the characteristics of the nonsteady drag coefficient behavior are shown to be frequently at variances with these findings.

Methods of Dynamic Exploration and the Study of the Compressible Boundary Layer. M. Plan. 9th Congres Intern. Mecan. Appl., Univ. Bruxelles 4, 184 (1957) 12 pp. French text; [From *Appl. Mech. Rev. 13,* 50 (1960) Jan.]

Results are reported of measured and theoretically calculated velocity profiles in compressible boundary layer over smooth flat plate with sharpened leading edge. Critical consideration is given to sources of error in use of stagnation pressure probes in boundary-layer measurements. Results with round and flattened probes are compared; far better agreement with theory is reported for use of round probes. Effect of probe size is reported and method of extrapolation to zero probe size is presented to produce "corrected" data showing close agreement with theory. Minute thicknesses of leading edge of test surface are reported to greatly affect boundary-layer thickness, surface stresses, and measurements of velocity profiles. Reviewer sees main value of the work in its condemnation of conventional flattened probes and in the method presented for determining effective center of finite round probes. W. Rice, USA

The Reciprocal Relationship between the Aerodynamics of Gas Blast Flows and the Technological Constants of the Process of Underground Coal Gasification. K. M. Leonovich. *Podzemn. Gazifikatsiya Uglei,* 32 (1957) No. 1 (7 pp. Russian text); [From *Appl. Mech. Rev. 13,* 49 (1960) Jan.]

The fundamental trends in the investigation of blower flows in the underground gasification of coal are discussed. Two principal conditions are laid down for the formation of combustible gases: 1) repeated introduction of the gas blow to the reacting coal face; and 2) reduction in heat losses after the oxidizing reaction. The interrelationship is investigated between the aerodynamic activity of the blow gas flows, humidity of the gas, thermal conditions in the cycle, and calorific power of the gas.

V. D. Sokolov
Courtesy Referativnyi Zhurnal, USSR
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Pulsation Damping in Pressure Gauge Connections. T. J. Williams. *Engineer, Lond. 207,* 5380, 378 (1959) May (2 pp.); [From *Applied Mech. Reviews 13,* 132 (1960) Feb.]

In a previous paper, author examined the errors which may occur when a liquid manometer gage is used to indicate the time-mean of a pulsating pressure or pressure differential. The requirements for the elimination of these errors were determined, and a form of liquid manometer gage was proposed which would determine accurately the true time-mean of a pulsating pressure differential. This article is concerned with the same problem in relation to mechanical pressure gages, that is, gages which rely on the displacement produced in a mechanical part, such as a tube or diaphragm, when subjected to a difference in pressure. Examples of gages of this kind are the Bourdon gage, the Schaffer gage, and the low-pressure gages designed on the aneroid principle.

From author's summary

Heat Transfer

Emissivity of Dispersed Carbon Particles. V. R. Stull and G. N. Plass. *J. Optical Soc. Am. 50,* 121 (1960) Feb. (9 pp.)

Emissivity of spherical carbon particles is calculated in both the infrared and visible regions of the spectrum. Scattering and absorption cross sections for individual particles are obtained from the Mie theory of scattering. A suitable dispersion equation is derived which represents the optical properties of carbon at flame temperatures. An expression is obtained for the radiation intensity emitted by a large number of dispersed particles which includes all higher order scattering processes. From these results the emissivity of carbon particles in flames is calculated for particle radii in the range from 50-800 A and for 10^9-10^{15} particles cm^{-2}. In addition the emissivity is obtained for several different particle size distributions which are representative of actual flames. A quantitative explanation is given for the occurrence of the intensity maximum at shorter wavelengths than corresponds to the blackbody maximum at the same temperature.

Heat Transfer to Moving Fluids. J. Coates and B. S. Pressburg. *Chem. Eng. 66,* 67 (1959) Dec. 28 (6 pp.)

Conduction and convection processes are described with regard to mechanics of heat transfer to moving fluids; but empirical correlations are necessary to express over-all heat transfer coefficients. Article discusses resistances in convective heat transfer, dimensional analysis for data correlation, correlations for low Reynolds numbers, film coefficients for phase changes and boiling coefficients. A table of correlations to find convection heat transfer coefficients is included.

Radiative and Conductive Heat Transfer in a Quiescent Gas-Solid Bed of Particles: Theory and Experiment. F. B. Hill and R. H. Wilhelm. *A.I.Ch.E. J. 5,* 486 (1959) Dec. (11 pp.)

Article concerns a study of radiation as a contributing mechanism in the transfer of heat between discrete solid particles. A theory for transfer in such systems is generalized to include planar-, spherical- and cylindrical-bed geometries; because of the particulate nature of the system the generalization is given in terms of finite-difference equations. Transfer experiments were performed in a quiescent cylindrical bed with an axial heat source and a cylindrical containing-wall sink. Heat fluxes and radial-temperature profiles were measured. As the experiments were arranged, only modest temperature gradients were established between source and sink, but the ambient sink temperature was taken in steps from 100-1000° C. For a bed of 3.8-mm diam. alumina spheres the ratio of heat transferred by radiation to that transferred by conduction was estimated to increase with average bed temperature from the order of 0.1 at 100° C to 1.2 at 1000° C. The effects of temperature on bed reflectivity and transmissivity and on apparent boundary-temperature discontinuities are discussed.

Some Problems on Heat Conduction in Stratiform Bodies. V. Vokicko. *J. Phys. Soc. Japan 14,* 216 (1959) Feb. (9 pp.); [From *Appl. Mech. Rev. 13,* 59 (1960) Jan.]

Problems of heat conduction in multilayer bodies are treated by solving finite numbers of unidimensional unsteady heat conduction equations with matching boundary conditions. The Laplace transform is used to give a general form of the solution. It is then applied to some special cases of simpler nature.

L. N. Tao, USA

Helium

Physical Properties Evaluation of Compounds and Materials. Part II. Compressibility of Helium at −10° to 130°F and Pressures to 4000 P.S.I.A. L. Stroud, J. E. Miller, and L. W. Brandt. *J. Chem. Eng. Data 5,* 51 (1960) Jan. (2 pp.)

Isothermal compressibility data for pure helium, showing comparisons between experimental and calculated values are presented. Plots of Z (PV/RT) vs P for each isotherm were drawn, which permit the calculation of Z for any temperature between −10° and 130°F.

Kinetics

Graphical Differentiation in Ammonia Synthesis Kinetics. R. B. Anderson. *Ind. Eng. Chem. 52,* 89 (1960) Jan. (3 pp.)

Application of the Temkin-Pyzhev equation to ammonia synthesis kinetics on iron catalysts was examined. In differential form this rate equation can be plotted as a straight line, and both constants can be evaluated directly. Constants obtained by differentiation and integration were essentially the same. Derivatives determined for a first-order rate equation to test the log-log method of graphical differentiation were usually within 3% of the actual values.

Kinetic Study of Fluidized Solids Entrainment. J. M. Andrews. *Ind. Eng. Chem. 52,* 85 (1960) Jan. (4 pp.)

Mechanism of catalyst entrainment from a vertically fluidized bed is related to the physical properties of the system and to a statistical function of particle energy distribution. Specifically related properties are catalyst entrainment rate, catalyst particle mass and bed outage. Resulting equations can be employed in designs and analyses of both dense phase beds and transfer lines. Further research is indicated to relate β, the entrainment rate constant, with physical properties of fluidizing medium and particles.

Mass and Heat Transfer in Chemical Kinetics. D. A. Frank-Kamenetzki. (Berlin: Springer-Verlag, 1959) 239 pp. German text. [From *Appl. Mech. Rev. 13,* 61 (1960) Jan.]

This is a German translation by J. Pawlowdki of a monograph published in Russian in 1947. An English translatoin has been published in 1955 by Princeton University Press. The book represents an analytical treatment of the interaction of mass and heat transfer with reaction kinetics. The following chapters are included: diffusion kinetics; influence of the Stephan flow; nonisothermal diffusion; chemical fluid dynamics; dimensional analysis of combustion; temperature distribution in a reacting mixture and steady theory of heat explosion; flame propagation; heat balance in heterogeneous exothermal reactions; and periodic processes in chemical kinetics.

E. R. G. Eckert, USA

Permeability

A New Calibration Technique for Gas Transmission Measuring Apparatus. T. McAvoy. *A.S.T.M.Bull.,* 52 (1960) Jan. (3 pp.)

Proposed calibration procedure uses compressive loads that simulate conditions during experimental transmission of gas through plastic sheeting. Volume calibration of certain transmission cells has been in error by the amount of compression of the filter paper that resulted from the absolute pressure difference across the test membrane. Results from cells that were not identically constructed did not agree among themselves and were not accurate.The same laws for calibrating the apparatus are used to calculate experimental results. Calibrating by new standard is claimed to bring all apparatus into virtually exact agreement and improve the accuracy of the results.

Phase Equilibria

Phase Equilibria in Hydrocarbon Systems. Volumetric and Phase Behavior of Ethane-*n*-Pentane System. H. H. Reamer, B. H. Sage, and W. N. Lacey. *J. Chem. Eng. Data 5,* 44 (1960) Jan. (7 pp.)

Typical graphical data are presented for experimental volumetric measurements and phase compositions, which were prepared from earlier reports. Tabulated data for molal volumes and phase composition are also given.

Solubility

Solubilities of Inert Gases in Water. 0°C to Near the Critical Point of Water. D. M. Himmelblau. *J. Chem. Eng. Data 5,* 10 (1960) Jan. (6 pp.)

Gases whose critical temperatures were below the freezing point of water were studied: oxygen, nitrogen, hydrogen, helium, xenon, and methane. Article presents correlation of the solubility of these gases as a function of temperature. Data are presented for the following combinations of gases by plotting the logarithm of Henry's law constant vs the inverse of the absolute temperature: oxygen, nitrogen, and hydrogen; helium, xenon, and methane; hydrogen and helium; nitrogen and methane; and oxygen and xenon.

Surface Area

The Quantum Mechanical Correction for the High Temperature Van Der Waals Interaction of Light Gases and Surfaces. A New Method of Determining Surface Area. M. P. Freeman. *J. Phys. Chem. 64,* 32 (1960) Jan. (6 pp.)

An experiment is reported in which the exact magnitude

of the effect of negative discrete energy levels in the potential energy well for gas-surface interaction is determined. Experiment involves the surface interaction of two kinds of gas molecules differing only in mass (H_2 and D_2 with about 1700 m^2. of a low ash charcoal surface) and the interpretation of the data with the high temperature equation of state for gas-surface interaction. Quantitative agreement of certain independently obtained parameters indicates that the quantum mechanical equation of state for these light gases is at least as good as the classical equation has been for interpreting data for the heavier gases.

Thermodynamics

Aspects of the Statistical Thermodynamics of Real Fluids. H. Reiss, H. L. Frisch, E. Helfand, and J. L. Lebowitz. *J. Chem. Phys. 32,* 119 (1960) Jan. (6 pp.)

By extending the ideas previously applied to the statistical mechanical theory of hard sphere fluids, an approximate expression has been determined for the work of creating a spherical cavity in a real fluid. In turn, the knowledge of this entity permits an evaluation of properties such as the surface tension and the normal heats of vaporization of fluids and the Henry's law constants of fluid mixtures. Agreement between calculated and experimental properties is satisfactory.

Potential Energy Constants, Rotational Distortion Constants, and Thermodynamic Properties for NH_3, ND_3; PH_3, PD_3; AsH_3, and AsD_3. S. Sundaram, F. Suszek, and F. F. Cleveland. *J. Chem. Phys. 32,* 251 (1960) Jan. (4 pp.)

Normal coordinate analyses have been made for ammonia, phosphine, and arsine by the Wilson FG matrix method. Using the data on anharmonicities, and the corresponding completely deuterated molecules, constants of the most general quadratic potential energy function have been obtained for all these molecules. Based on former techniques, rotational distortion constants of all the six molecules have been determined and compared with the results obtained from previous rotational spectral data. Molar thermodynamic properties, heat content, free energy, entropy, and heat capacity also have been calculated for temperatures from 100-1000°K for ideal gaseous state at one atm. pressure and for rigid-rotar, harmonic-oscillator approximation.

Thermodynamic Characteristics for Comparing Cycles of Heat Power and Refrigerating Machines. V. S. Martinovsky. Proc. 3rd Cong. Theor. Appl. Mech., Fangalore, India: Indian Soc. Theor. Appl. Mech., Indian Inst. Technol, Kharagpur, 1957, 301 (15 pp.); [From *Appl. Mech. Rev. 13,* 134 (1960) Feb.]

Practical cycles operate with widely varying temperatures of the working substance. Author shows how introduction of rather simple equivalent temperatures permits construction of equivalent Carnot cycles which, in turn, allow an immediate estimate of the theoretical thermaldynamic efficiency. The equivalent temperature of the heat input part A to B of a cycle is calculated thus: T_{AB} = Integral from A to B of $Tds/(S_B - S_A)$. A similar averaging process is carried out for the heat-rejection part. The plot of the equivalent cycle on T-S coordinates then appears as a rectangle with opposite corners at T_{AB}, S_B; T_{BA}, S_A. Regenerative cycles, cycles with superheat, and corresponding refrigerating cycles are discussed in this way. Concluding sections deal with the comparison of cycles of identical temperature limits, but differing in either their range of volume or pressure characteristics.

W. Hitschfeld, England

Thermodynamic Properties of Air in the Temperature Interval from 1000 to 12,000°K and the Pressure Intervals from 0.001 to 1000 atm. E. V. Stupochenko, K. P. Stakhanov, E. V. Samuilov, A. S. Pleshanov, and I. B. Rozhdestvenskii. Physical Gasdynamics. USSR Aca. Sci. (pp. 3-38); [From *ARS J. 30,* 98 (1960) Jan. (15 pp.)]

Since direct methods for study of gases at high temperatures are not developed, the methods of statistical physics (quantum mechanical), with spectroscopic data, are the basis for calculation of thermodynamics of gas systems and chemically reacting gas mixtures. Thus air, besides dissociation of oxygen and nitrogen and formation of nitric oxide, also presents ionization of molecular and atomic components. The problem resolves into two stages calculation of thermodynamic parameters of "pure" components and calculation of the composition of air and its thermodynamic functions. The parameters can be calculated in statistical sums. The composition is found by solving a system of nonlinear algebraic equations which include those of the law of effective masses for each possible reaction. Each ionization process, as well as equations for Dalton's law, material balance, and charge conservation, and the thermodynamic functions are found by solving two systems of linear equations. Method of calculations are outlined, tabulated spectroscopic constants are given, the electronic states, equations of chemical equilibrium, reacting ideal gases are discussed. Functions were calculated and graphed for enthalpy, internal energy, entropy, molecular weight, specific heats, velocity of sound, and density.

Water

The Composition and Enthalpy of Dissociated Water Vapor. P. J. Friel and R. C. Goetz. *J. Phys. Chem. 64,* 175 (1960) Jan. (3 pp.)

Results, presented in graphs, of the enthalpy and composition of dissociated water vapor to 5000°K for total pressures between 0.001 and 10 atm. assuming the gas mixture to be in chemical equilibrium are described.

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Bituminous Coal Research
Brennstoff-Chemie (German)
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